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ABSTRACT

This is part one of two performance assessment resources booklets for Level I of the Intermediate Science Curriculum Study (ISCS). The two booklets are considered one of four major subdivisions of a set of individualized evaluation materials for Level I of the ISCS developed as a part of the ISCS Individualized Teacher Preparation (ITP) program. Each booklet is a teacher's handbook to be used in identifying the appropriate performance checks with which to evaluate each student. Each also indicates how to set up testing situations, correct responses, and give remedial help. This manual (part 1) covers the first five units of Level I (1-5) in eleven chapters. Each unit begins with a summary table that includes the objectives and performance checks of the unit. Immediately following each summary table comes the bulk of the resource material for each objective introduced in that unit. Suggestions of ways teachers can use the manual are also included. (HM)

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ISCS

INTERMEDIATE SCIENCE CURRICULUM STUDY

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INDIVIDUALIZED TESTING SYSTEM

Performance Assessment Resources

ISCS LEVEL I

PART 1

SE 028 464

SILVER BURDETT
GENERAL LEARNING CORPORATION
Morristown, New Jersey · Park Ridge, Ill. · Palo Alto · Dallas · Atlanta

INDIVIDUALIZED TESTING SYSTEM

ALL LEVELS	**Individualizing Objective Testing** (an ITP module) **Evaluating and Reporting Progress** (an ITP module)
LEVEL I	**Performance Objectives,** ISCS Level I **Performance Checks,** ISCS Level I, Forms A, B, and C **Performance Assessment Resources,** ISCS Level I, Parts 1 and 2
LEVEL II	**Performance Objectives,** ISCS Level II **Performance Checks,** ISCS Level II, Forms A, B, and C **Performance Assessment Resources,** ISCS Level II, Parts 1 and 2
LEVEL III	**Performance Objectives,** ISCS Level III **Performance Checks,** ISCS Level III, ES-WB, Forms A, B, and C WYY-IV, Forms A, B, and C IO-WU, Forms A, B, and C WW-CP, Forms A, B, and C **Performance Assessment Resources,** ISCS Level III, ES-WB WYY-IV IO-WU WW-CP

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MATERIALS DEVELOPMENT CONTRIBUTORS

Betsy Conlon Balzano, State University of New York at Brockport
Thomas Boehm, State University of New York at Albany
Linda Dubaldi, F.S.U.
William H. Fletcher, F.S.U.
John R. Hassard, Georgia State Univeristy
H. Dale Luttrell, North Texas State University
Mildred MacMullen, Hudson, New York
E. Wesley McNair, F.S.U.
Luis A. Martinez-Perez, F.S.U.
Charles Mielcarski, Averill Park, New York
Lawrence E. Oliver, F.S.U.
Barney Parker, F.S.U.
Everett S. Stallings, F.S.U.
Paul H. Westmeyer, F.S.U.

FOREWORD

To implement an educational approach successfully, one must match the philosophy of evaluation with that of instruction. This is particularly true when individualization is the key element in the educational approach. Yet, as important as it is to achieve this match, the task is by no means simple for the teacher. In fact, without specific resource materials to help him, he is apt to find the task overwhelming. For this reason, ISCS has developed a set of individualized evaluation materials as part of its Individualized Teacher Preparation (ITP) program. These materials are designed to assist teachers in their transition to individualized instruction and to help them tailor their assessment of students' progress to the needs of all their students.

The two modules concerned with evaluation, *Individualizing Objective Testing* and *Evaluating and Reporting Progress*, can be used by small groups of teachers in in-service settings or by individual teachers in a local school environment. Hopefully, they will do more than give each teacher an overview of individualized evaluation. These ITP modules suggest key strategies for achieving both subjective and objective evaluation of each student's progress. And to make it easier for teachers to put such strategies into practice, ISCS has produced the associated booklets entitled *Performance Objectives, Performance Assessment Resources,* and *Performance Checks.* Using these materials, the teacher can objectively assess the student's mastery of the processes, skills, and subject matter of the ISCS program. And the teacher can obtain, at the moment when they are needed, specific suggestions for remedying the student's identified deficiencies.

If you are an ISCS teacher, selective use of these materials will guide you in developing an individualized evaluation program best suited to your own settings and thus further enhance the individualized character of your ISCS program.

The Co-Directors
Intermediate Science Curriculum Study
Rm 415, W.H. Johnston Building
415 North Monroe Street
Tallahassee, Florida 32301

THE ISCS INDIVIDUALIZED TESTING SYSTEM

The ISCS individualized testing system for each level of ISCS is composed of four major subdivisions:

1. The ITP modules *Evaluating and Reporting Progress* and *Individualizing Objective Testing,*
2. *Performance Objectives,*
3. *Performance Checks* in three alternate forms, and
4. *Performance Assessment Resources.*

Evaluating and Reporting Progress presents a comprehensive overview, with many refinements, for individualizing the grading and reporting of students' progress, based on both subjective and objective criteria. The module *Individualizing Objective Testing* describes more specifically those ISCS evaluation materials which have objective criteria – the performance objectives, checks, and resources – and it presents practical suggestions for their use. These two modules should be considered prerequisite to successful use of the other ISCS evaluation materials.

Each of the *Performance Objectives* booklets contains a composite list of selected measurable objectives considered important to a given level of the ISCS program. However, many of the long-range goals and aims that are at the heart of the ISCS program do not lend themselves to being expressed as measurable performance objectives. Thus, these booklets should not be construed as being all-inclusive anthologies of all the possible learning outcomes of ISCS.

Each of three *Performance Checks* booklets contains an equivalent but alternative set of performance checks which were developed to assess the students' achievement of the objectives stated in the *Performance Objectives* booklets.

The *Performance Assessment Resources* booklet is a teacher's handbook to be used in identifying the appropriate performance checks with which to evaluate each student. The booklet also indicates how to set up testing situations, correct responses, and give remedial help.

NOTES TO THE TEACHER

An overview of evaluation, including both objective and subjective criteria, is given in the module *Evaluating and Reporting Progress.* Many aspects of this booklet are described in more detail in Chapter 3 of the module *Individualizing Objective Testing.* These notes are meant to augment, not replace, Chapter 3 of that module. As you use this booklet, you will begin to see ways to modify its suggestions to meet your needs better. You are encouraged to enter your modifications at the points where they apply. Only by altering these materials will you evolve an evaluation system best suited to your own classroom environment. It is important to remember that only principles involved in objective criterion-referenced evaluation are applied in this booklet. Therefore, you will obviously want to incorporate subjective criteria also.

Units and Chapters

There are at least two *Performance Assessment Resources* booklets for each level of ISCS. These booklets are divided into units, thus breaking up a single level of the ISCS program into easily handled sections of correlative chapters. The relationship between the units and the chapters of *Probing the Natural World* are shown in Table 1.

LEVEL I

UNIT	CHAPTERS	EXCURSIONS
1	1 and 2	1 thru 3
2	3 and 4	4 thru 8
3	5 thru 7	9 thru 14
4	8 and 9	15 thru 19
5	10 and 11	20 thru 22
6	12 and 13	23 thru 27
7	14 and 15	29 thru 33
8	16 and 17	34 thru 39
9	18 and 19	40 thru 44
10	20 and 21	45 thru 48

Table 1

As you can see from Table 1, most units include the objectives and performance checks for two chapters and their related excursions. The individual objectives and performance checks for each unit are to be selected and used when the student has completed the entire unit. This delay should ensure that there is no premature assessment of the student's achievement of concepts and skills which may be introduced early in a unit, but which require development throughout the unit. Thus, subdividing units for assessment purposes should be done with great care. Keep this in mind if you decide to spot check students as they proceed through units, rather than conducting a formal evaluation at the end of the unit.

Summary Table

Each unit begins with a double-spread "Performance Check Summary Table." The left-hand page of the "Summary Table" serves as a table of contents for the unit. It provides a great deal of information about the objectives pertinent to the unit. Usually about twenty-five objectives for each unit are introduced for the first time in each "Summary Table." A maximum of ten relevant objectives from previous units are reintroduced.

On the left-hand side of the "Summary Table" is a list of code numbers, each of which is unique to one objective within the level. Two examples of code numbers and their meanings are illustrated in Figure 1 below.

03 -	Core -	17	and	05 -	Exc	19 -	2
unit	based on core material	17th objective in unit		unit	based on excursion material	excursion number	2nd objective for excursion

Figure 1

The core objectives first appear in an order that corresponds roughly to the text development. Exceptions to this ordering were made to place objectives based on related processes or content together. Objectives based on remedial excursions are numbered as core objectives because they involve skills essential to success in core activities. Next are listed the general or enrichment excursion objectives, and these are followed by objectives from prior units which are again considered important to the students' progress. These repeated objectives are easily spotted, as a capital R (for Repeated) appears after their identifying code number, giving a listing such as 03-Core-17R. The specific resource aids to be used with repeated objectives are given in the units designated by the code number (unit 3 in the just-cited example), and the information is not repeated each time within the textual material that follows the "Summary Table."

Each objective code number is followed by a short descriptive statement of that objective. These short statements were written, using the students' vocabulary. They should be helpful in communicating the objectives to the students should you desire to do so. Ways to involve your students in selecting the objectives are discussed in the module *Individualizing Objective Testing.*

The right side of the "Summary Table" is made up of eleven columns. Letters are used in the first five to designate the characteristics of the performance check. The letters and their meanings are as follows:

M - Completing the check requires regular ISCS materials.
O - An observer should view the student's performance as he does the check.
P - Completing the check requires the use of specially prepared materials.
Q - The answer to the check is of the quick-scoring variety.
T - The check will require more than three minutes of the student's time.

Check marks in the next four columns help the teacher assign appropriate performance checks to individual students. The first of these columns is entitled "Basal." Achieving the objectives checked in this column is considered essential to most students' success with the total unit. These performance checks may be assigned to any student; however, better students will find that many of these offer little or no challenge.

Check marks in the columns headed "Math," "Reading," and "Concept" indicate performance checks which require a higher level of computational skills, a higher reading level, or a greater ability to think abstractly than the performance checks for most other objectives. Performance checks which have no marks in any of these four columns are considered to be more than basal, but the skills which they require are within the capability of most students.

A tenth column lists the action verb that identifies the theoretical mental process required of the student to complete the performance check for the objective. A precise definition of each of the verbs used to designate mental processes is given in the module *Individualizing Objective Testing.*

Finally, in the eleventh column, space is provided for notes. Although you will find an occasional comment printed here, this space is mainly for your notes. It's a good place to put any special instructions or preparations you have found helpful.

As mentioned earlier, some objectives are repeated objectives – ones that have appeared in previous units. When such an objective is listed again in the "Summary Table," its classification as basal or as presenting math, reading, or conceptual difficulties is likely to be different. This change most often derives from a change in purpose. The first time a concept or skill is introduced, the intent may be only to introduce students to it. When reintroduced in a later unit, the skill or concept is frequently developed and used extensively. Thus, in the "Summary Table" for the earlier unit, objectives related to a concept are likely to be classified as conceptually difficult for many students, whereas in the later units, the same objective might be reclassified as basal.

Organization of Resources

Immediately following each "Summary Table" comes the bulk of the resource material for each objective introduced in that unit. Once more, each objective is identified by its code number, but this time it appears in bold, black print in the outer margin directly beside the applicable resource. A pair of horizontal lines separates the resources for each objective from those for the previous and following objectives. When no horizontal line appears at the bottom of a page, the objective is continued on the next page.

The list immediately following delineates the functions of the various component resources provided for the objectives. Two of the components (Regular Supplies, Special Preparations) only appear when they are needed for a particular item. Many of the performance checks, for example, do not require any supplies, so supply headings are omitted. Observe the functional descriptions carefully – they are the keys to the types of resource materials provided in the *Performance Assessment Resources* booklet.

COMPONENTS	FUNCTION
Descriptive Statement	This statement duplicates the one that appears in the "Summary Table." If you misread a code number and find yourself looking at material for the wrong objective, this should stop you and send you back to the Table to check. More important, it should briefly indicate to you the basic purpose of the objective.
Objective	The underlined verb in this statement of the objective indicates the theoretical mental process that the student will perform. The phrase following it indicates the content or process skill which the student must perform. A complete description of the verbs and their meanings can be found in the ITP module *Individualizing Objective Testing.*
Regular Supplies	This section lists any ISCS equipment that the student will need – regular equipment that is being used in the unit on which the student is being evaluated or in previous units.
Special Preparations	Don't overlook this section. It lists and describes materials the teacher must collect or prepare in some way. Included are special solutions, special packaging, and labels required for materials for evaluation purposes. The section also specifies particular grids that the students will need for graphing.
Student Action	This is a general description of what the student should do in responding to any of the three performance checks based on the objective. If his expected response is to state a general principle, it is listed in this section. If the three performance checks require specific answers, they are provided below the general statement in the student action.
Performance Check A	Performance Check A is fully stated to allow for a quick review of the statement of the tasks as they are presented to the student. Performance Checks B and C generally present slightly different situations or wording but ask students to perform equivalent tasks.

Remediation	This final section outlines suggested action that can be taken if the student fails to achieve the objective. In some of the remediations, the listed steps are sequential; in others the steps represent options from which it is suggested that you select one or two. Some remediations suggest referring the student to review sections of the core, doing an excursion, or reviewing a self-evaluation question and its response.

How to Find It

Locating a particular objective whose number you know is easy. Just thumb through the pages watching for the unit number which appears in large black print above the word *core* or *excursion* in the margins. But suppose you wish to locate an objective pertinent to a given section or chapter of the text and you don't know the number. Here is a procedure to follow:

1. Determine the unit in which the chapter occurs, using Table 1.
2. Thumb through this booklet until you find that unit number as the beginning digits of any code number appearing in large black print in the outer margin.
3. Look for the "Summary Table" at the beginning of that unit.
4. Use the "Summary Table" to determine the number of the objective you seek.

Be Selective

The resource books for each level contain many more objectives and resources than any one teacher can use. If you add objectives and resources, and you probably will, your list will expand further. The most successful user of this catalog will be the teacher who picks and chooses selectively to meet the specific needs of his students. Therefore, once you are familiar with this book, it is imperative that you establish a system of selecting and assigning checks to the student. Suggestions on how to establish such a system are given in Chapter 3 of the module *Individualizing Objective Testing.*

Whatever selection and assignment system you develop, it must give due regard to individual student's differences. For example, if you administer too many recall performance checks to a high-ability student, he will not only be bored but you will also fail to assess his progress adequately. Too many difficult items administered to a low-ability student leads to frustration and reinforcement of the "I knew I couldn't do it" attitude. On the other hand, even the best students need their egos inflated by some questions that they can answer easily. And, the less able student needs to be appropriately challenged. Be careful, too, of placing too much emphasis on objectives. This may lead students to place undue emphasis on tests, thus slowing their progress to the extent that they lose interest in the story line.

Assigning Performance Checks

How many performance checks should be assigned to a student? This question has no fixed answer. The primary concern is that performance checks provide the needed feedback to both you and the student. If, in your judgment, evaluating a student on a particular unit is unnecessary, then don't do it. If you feel a student needs to be evaluated, then assign an appropriate selection of performance checks. *Individualizing Objective Testing* makes suggestions about how to do this. In no case should any student be assigned all the performance checks or even a random sampling of them. Such a practice would subject the student to tasks which would be either unduly difficult and time-consuming or perhaps too simple for him and therefore meaningless, time-wasting activities.

You may wish to specify the equivalent form (A, B, or C) of performance checks that the student should do when assigning the specific performance check numbers. There is, of course, no difference in their difficulty level. In any case, have the student record both the number and the letter of the specific performance check he does. These numbers and letters should appear on his answer sheet, as they will be needed to check his response. Since the numbers are unique within each ISCS level, there is no need to use a student's time copying the performance checks. Listing the number with the response is sufficient. It's a good idea to remind students frequently that their answers must go on separate paper – not in the *Performance Checks* books.

As you assign checks, keep the supply situation in mind. You won't want too much of some equipment tied up in Special Preparations at any one time. To avoid this, keep abreast of the range of your students' progress and prepare only those materials you anticipate needing, referring to the P's appearing in the third column on the right-hand page of the "Summary Table." Batteries, of course, will need replacement or recharging occasionally, and specially boxed supplies should be checked periodically for missing or nonfunctioning parts.

At the back of Part 2 of the *Performance Assessment Resources,* you will find grids identical to those the students must use in certain performance checks. The grids at the back are suitable for reproduction. You may make copies directly, using one of the well-known commercial copiers. For large quantities at low cost, make a master by the thermo process and use it to make duplicates. If you make copies in either of these ways, your students will not be wasting time drawing grids, and you will feel free to assign objectives that need grids.

01

Chapters 1 and 2

Excursions 1 thru 3

Performance Check

Summary Table

Objective Number	Objective Description
01-Core-1	Makes simple circuit connections
01-Core-2	Indicates simple circuit connections
01-Core-3	Recognizes variables as changing or affecting activities
01-Core-4	Locates by substitution a nonfunctioning element in a circuit
01-Core-5	Selects batteries capable of influence
01-Core-6	Explains applications of influence output in terms of influence input
01-Core-7	Matches terms *system, subsystem,* and *component* to definitions
01-Core-8	Selects simple electrical systems from among nonsystems
01-Core-9	Measures length in centimeters
01-Core-10	Measures time in seconds with a metronome timer
01-Core-11	Selects advantages of using data tables
01-Core-12	Locates specified data in a table
01-Core-13	Selects a characteristic included in an operational definition
01-Core-14	Divides decimal numbers
01-Core-15	Multiplies decimal numbers
01-Core-16	Adds decimal numbers
01-Core-17	Subtracts decimal numbers
01-Core-18	Cleans up work area at close of class

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
	M	O		Q	T	√				manipulates	
				Q		√				applies	
				Q				√	√	classifies	
	M		P	Q	T	√				classifies	
	M		P	Q	T	√				applies	
									√	applies	
				Q					√	classifies	
									√	applies	
	M			Q		√				manipulates	
	M	O		Q		√				applies	
				Q				√	√	recalls	
				Q		√				applies	
				Q					√	recalls	
				Q		√				applies	Also use with Excursion 2.
				Q		√				applies	Also use with Excursion 2.
				Q		√				applies	Also use with Excursion 2.
				Q		√				applies	Also use with Excursion 2.
	M	O		Q		√				chooses	

01

Objective Number	Objective Description
01-Core-19	Cooperates with lab partners
01-Core-20	Returns equipment promptly to storage areas
01-Core-21	Responds to text questions
01-Core-22	Shows care for laboratory materials
01-Exc 01-1	Recognizes advantages of the metric system
01-Exc 01-2	Selects the system of measurement used in ISCS
01-Exc 03-1	Distinguishes between direct and inferred comparisons

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
		O		Q		✓				chooses	
	M	O		Q		✓				chooses	
		O		Q		✓				chooses	
	M	O		Q		✓				chooses	
				Q						recalls	
				Q		✓				identifies	
				Q				✓	✓	classifies	

01 Core 1

Makes simple circuit connections.

The student manipulates the given materials to make a simple circuit.

Regular Supplies:
1 rechargeable battery
2 test leads
1 bulb
1 socket

Student Action: Connecting materials so that bulb lights. (See Teacher's Note.)

Teacher's Note: The point of the objective is to see if the student can make the proper circuit connections. If a battery, bulb, or test lead is faulty, causing the bulb not to light, the student should still be given credit for successfully carrying out the objective if he has interconnected the components correctly.

Performance Check A: Get two test leads, a bulb and socket, and an ISCS battery from your teacher. Charge the battery for one minute. Get your teacher to watch you. Now connect the bulb to the battery so that the bulb lights.

Remediation: (1) Direct the student to restudy Activities 1-11 and 1-12 on pages 4 and 5 of *Probing the Natural World/1* if he failed to charge his battery adequately. (2) If he had trouble making the proper circuit connections, suggest he look at the first two pages of Excursion 26 (pp. 427-428). (3) Counsel the student as needed.

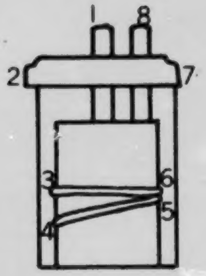
01 Core 2

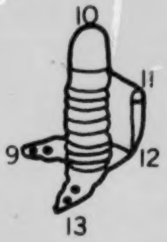
Indicates simple circuit connections.

The student applies the concept of a simple circuit as a complete electrical path.

Student Action: Selecting the numbers which indicate the connections necessary to complete the circuit on a diagram similar to the one shown below.

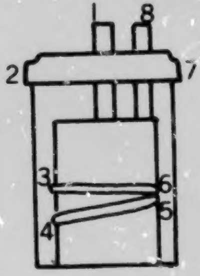
(Numbers shown here are those appearing in art for Check A only.)

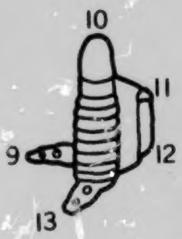




A: 1 to 9 and 8 to 13 or 1 to 13 and 8 to 9
B: 6 to 5 and 13 to 4 or 6 to 4 and 13 to 5
C: 8 to 10 and 7 to 11 or 7 to 10 and 8 to 11

Performance Check A: Study the diagram below to see how you should connect test leads to make the bulb light. Then, write the two numbers for each test lead that show where the ends of each lead should be connected.





Remediation: (1) Direct the student to look at the diagram in Activity 1-12, page 5, of *Probing the Natural World/1.* (2) Have him compare the connections he drew from the battery to the bulb with those shown in Activity 1-12. (3) Ask him to change his response to agree with the activity diagram. (4) Ask him to explain why the change was necessary. If you are not satisfied with his response, suggest he look over pages 427 and 428 of Excursion 25.

01
Core
3

Recognizes variables as changing or affecting activities.

The student classifies something that changes in an activity or experiment and affects its results as a variable.

Student Action: Selecting "a variable."

A: d
B: b
C: c

Performance Check A: Something that changes in an activity or experiment and affects the results of it is called

a. an example.
b. a solution.
c. a problem.
d. a variable.

Remediation: (1) Direct the student to restudy the final paragraph on page 17. (2) Determine whether his response to question 2-23 includes two variables (thickness of shaft and length of time of battery charge). (3) Discuss with the student his response to question 2-23, and ask for a verbal definition of *variable*. (4) Reassess the objective using an alternate performance check.

01

Locates by substitution a nonfunctioning element in a circuit.

The student classifies the nonfunctioning component in a given electrical circuit by substituting functioning components until the nonfunctioning component is identified and the system functions.

Core 4

Special Preparations: One numbered shoe box for each performance check, equipped as indicated below.

A: Box 01-Core-4A contains 1 burned out bulb connected in a prewired circuit with 2 test leads, a socket, and charged battery, as well as a spare bulb, an extra charged battery, and an extra test lead.

B: Box 01-Core-4B contains 1 uncharged battery connected in a prewired circuit with 2 test leads and bulb and socket, as well as a spare bulb, an extra charged battery, and an extra test lead.

C: Box 01-Core-4C contains 1 faulty test lead connected in a prewired circuit with a charge battery, bulb and socket, and test lead, as well as a spare bulb, an extra charged battery, and an extra test lead.

Student Action: Selecting the nonfunctioning component.
A: Bulb
B: Battery
C: Test lead

Performance Check A: In box 01-Core-4A you will find a circuit all set up. Use the good spare parts in the box to find out why the bulb doesn't light. Which part is bad?

Remediation: (1) Direct the student to study the material between Activities 1-12 and 1-13 on page 5 and pages 427 and 428 of Excursion 26 in *Probing the Natural World/1.* (2) Ask the student how he found out if the bulb and test leads were good. (He may have skipped this on his first pass through the chapter.) (3) Ask the student how to check a battery for charge. (4) Use an alternate performance check for reassessment.

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01 Core 5

Selects batteries capable of influence.

The student applies the concept that a battery which has influence can operate appropriate electrical devices.

Regular Supplies:	3 test leads	1 motor
	1 bulb and socket	1 battery holder

Special Preparations: One shoe box numbered 01-Core-5 containing the following: 3 dead flashlight batteries labeled A, C, and E and 3 charged flashlight batteries labeled B, D, and F.

Student Action: Reporting which batteries have influence.
A: Battery D
B: Battery B
C: Battery F

Performance Check A: Get batteries A, C, and D from box 01-Core-5. Use any other materials you think you need. Which of the batteries has influence?

Remediation: (1) Ask the student what *influence* means. If his response is satisfactory, his difficulty must be in determining whether the batteries are charged. If the response is unsatisfactory, he should review the first two paragraphs and question 1-1 on page 1 of his text. Also, he should review questions 1-10, 1-11, 1-12, and 1-13 and his responses. (2) Ask the student to restudy page 5 of his text and his responses to questions 1-2 and 1-3. Then determine if he did, in fact, test the bulb and test leads. Ask him how to test a battery for charge. Reassess the objective with an alternate performance check.

---

01 Core 6

Explains applications of influence output in terms of influence input.

The student applies to common situations the concept that influence must be applied to an object to get influence back from it.

Student Action: Responding to the effect that influence must be applied to get influence back.

Performance Check A: A hammer is used to transfer influence to a nail. Why must you swing a hammer before it can drive a nail into wood?

Remediation: (1) Determine whether the student knows what is meant by *influence.* If he doesn't, see Remediation (1) under 01-Core-4. (2) If he does, ask whether a hammer lying on the table can influence a nail into a board. Or ask what is meant by "driving a nail?" Is driving a nail influencing the nail? What does he do to the hammer that causes it to influence the nail? (3) Reassess, using an alternate performance check.

---

01 Core 7

Matches terms *system, subsystem,* and *component* to definitions.

The student classifies a system as a group of objects that interact with each other, a subsystem as a group of objects that directly interact with each other within a system, and a component as an object that is part of a system.

Student Action: Matching the terms *system, subsystem,* and *component* with their definitions.

A: 1. d, 2. a, 3. b
B: 1. c, 2. d, 3. a
C: 1. c, 2. b, 3. a

Performance Check A: Match the following terms by first listing the numbers (1, 2, and 3) on your paper and then writing after each number the letter (a, b, c, or d) of the correct matching definition.

Terms

1. Component
2. Subsystem
3. System

Definitions

a. A group of objects that directly interact with each other within a system
b. A group of objects that interact with each other
c. An object that does not interact with other objects
d. An object that is part of a system

Remediation: (1) Check the student's responses to questions 1-7, 1-8, and 1-9. (2) If any of these has been omitted or is incorrect, ask the student to study pages 8 and 9 in *Probing the Natural World/1* and to check his response to Self-Evaluation questions 1-3 and 1-7. (3) The systems concept appears again in Chapter 6. The student may then be assessed with other performance checks for this objective.

01 Core 8

Selects simple electrical systems from among nonsystems.

The student applies the definition that a system is a group of objects which interact with each other.

Student Action: Selecting the diagrams in which the components are shown assembled to interact as a system and stating the notion of the definition as the reason that the components interact with each other.

A, B, and C: a and b

Teacher's Note: The student should be led to see that a completed circuit is required for interaction among the elements to occur.

Performance Check A:

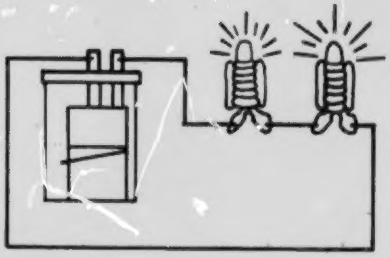


Diagram a

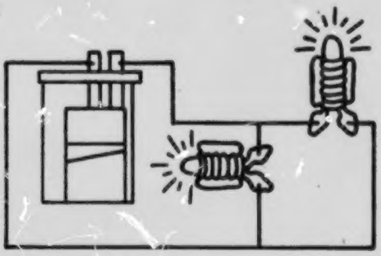


Diagram b

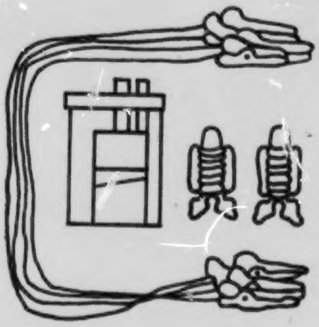


Diagram c

On your paper, write the letter of each diagram which identifies a system. Also explain why the diagram or diagrams you chose represent systems.

Remediation: (1) Check the student's responses to questions 1-7, 1-8, and 1-9. (2) If these questions were omitted or are incorrect, ask the student to study pages 8 and 9 in the text and to check his response to Self-Evaluation questions 1-3 and 1-7. (3) The systems concept appears again in Chapter 6, and the student may then be assessed with other performance checks for this objective.

01 Core

Measures length in centimeters.

The student manipulates a metric ruler to find the distance in metric units between specified pairs of points.

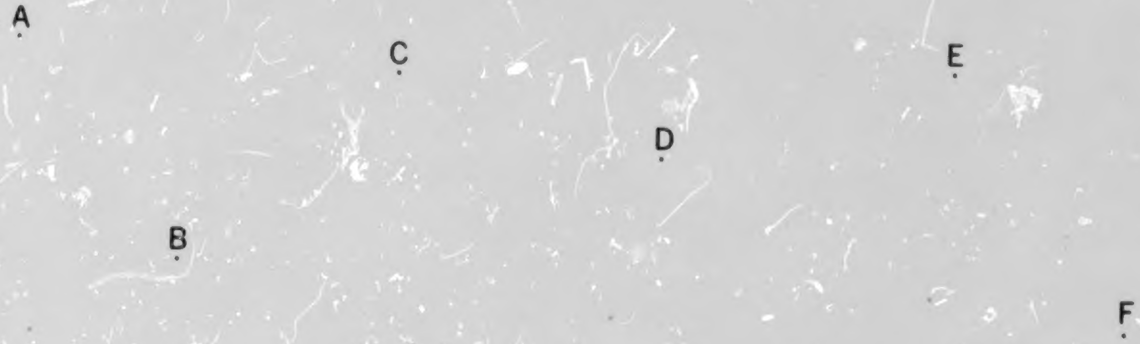
Regular Supplies: 1 metric ruler

9

Student Action: Measuring and reporting the distance between three designated pairs of points to the nearest 0.2 cm correctly in at least two of the three cases.

A: A to B, 3.9 cm; C to F, 11.3 cm; D to E, 4.5 cm
B: A to F, 16.7 cm; C to D, 4.1 cm; B to C, 4.2 cm
C: C to A, 5.5 cm; B to D, 7.2 cm; F to E, 4.5 cm

Performance Check A:



On the diagram above, measure the distance between the following points to the nearest 0.1 cm.

1. What is the distance from point A to point B?
2. What is the distance from point C to point F?
3. What is the distance from point D to point E?

Remediation: (1) Review Excursion 1, pages 281 and 282 in the text. (2) Practice measuring various book illustrations and recording the results. (The width of the red margin on page 191 is 15.3 cm and the height is 9.0 cm.) (3) Reassess the student, using an alternate form of the performance check.

01
Core
10

Measures time in seconds with a metronome timer.

The student applies the procedure for timing an event with a metronome timer by telling the teacher to start a specified activity on a click and then counting only subsequent clicks until the teacher stops the activity.

Regular Supplies: 1 metronome (ISCS) timer

Student Action: Reporting the elapsed time in seconds to the nearest whole second.

Teacher's Note: The teacher must be prepared to start an activity, such as tapping on a table, pouring water, or moving a pencil back and forth, on command from the student and to stop the activity within 4 to 7 seconds on a metronome click. A trustworthy student may perform the tasks for other students to time. Remember the person performing the task should be instructed to stop on a click.

Performance Check A: Ask your teacher or his assistant to begin tapping on the desk for you. Tell him when to begin. Use your ISCS timer to find out how long he taps the desk.

Remediation: (1) The student's difficulty will most probably be that he didn't subtract one click of the timer from the total number of clicks during the event. Since the event being timed begins with a click, the first click either should not be included in the counting process or should be subtracted from the total count. A suggestion to him that the timer clicks between seconds and asking how many clicks he would have to hear to measure the first second, and then how many to measure two seconds, may be helpful. (2) Repeat the activity he failed, and discuss the result you get compared to his result. Try to arrive at the reason for the failure in this manner. (The basic timer information is in the text on page 15.)

---

01 Core 11

Selects advantages of using data tables.

The student recalls that data tables are used because they make finding relationships between variables easier, they tend to reduce errors by organizing data, they provide an organized way to store data, and they help to insure that the data needed are collected.

Student Action: Selecting either the entry "all of these" or at least three of the four other entries.

Performance Check A: On your paper write the letters of all good reasons for using data tables.

a. Data tables store data in an organized way.
b. Data tables tend to reduce errors by organizing data.
c. Data tables make it easier to find relationships.
d. Data tables help make sure you collect the data you need.
e. All of these.

Remediation: None at this time, other than to show the student the accepted response. Further assessment of this objective will come later.

---

01 Core 12

Locates specified data in a table.

The student applies the procedure for locating specified bits of data in a data table.

Student Action: Selecting three specified bits of data.

A: 1. 85 cm; 2. 6300 cm; 3. 50
B: 1. 80 cm; 2. 5100 cm; 3. 70
C: 1. 90 cm; 2. 4000 cm; 3. 60

Performance Check A:

Name of Group Member	No. of Sinkers Dragged	No. of Times Dragged	Distance from Hook to Pulley (cm)	Total Distance Dragged (cm)	Total Time for Dragging (sec)
Sue	1	70	90	6300	120
Betty	2	60	85	5100	110
Sam	3	50	80	4000	105

Study the table. Use it to answer all the questions below.

1. What was the distance in centimeters from hook to pulley when two sinkers were dragged?
2. What was the total distance in centimeters that one sinker was dragged?
3. How many times were the three sinkers dragged?

Remediation: (1) Check the student's *Record Book* for the data in his copy of Table 2-3. (2) Ask him to find data for you from that table. (3) Discussion of his responses should indicate whether further practice is needed.

Selects a characteristic included in an operational definition.

O1
Core
13

The student recalls that an operational definition includes a procedure for measuring that which it defines.

Student Action: Selecting the phrase "the way to measure."

A: d
B: c
C: b

Performance Check A: What is the letter of the phrase below which correctly completes the sentence?

An operational definition includes a description of ___ the thing being defined.

a. the way to classify
b. the texture and color of
c. the shape or odor of
d. the way to measure

Remediation: This objective is classed as basal to the ISCS course, but the concept of an operational definition grows slowly. If the student misses this check, have him read the first two paragraphs on page 11 and his answers to questions 2-1 and 2-2 in the text. Suggest that he review these before the next unit assessment. Opportunities to follow up on this objective appear in subsequent chapters of the student's text.

01 Core 14

Divides decimal numbers.

The student applies the rules of division to find a quotient.

Student Action: Calculating the quotient to an accuracy of one decimal place and showing his work.

A: 5.8 or 5.9
B: 1.7 or 1.8
C: 4.2

Performance Check A: On your paper, divide 12.34 by 2.1. Round off your answer to one number after the decimal point.

Remediation: Inability to divide decimal numbers is a very common problem with junior high and middle school students. Excursion 2 is remedially oriented and should be helpful to some students. However, giving a simple problem quiz each week for four or five weeks will also prove helpful and give the student both further practice and the incentive to master the fundamentals. The student should not be held back from further activities in the core because of his failure with this objective. Rather, encourage him to apply the algorithms in the excursion to his math problems and go ahead.

01 Core 15

Multiplies decimal numbers.

The student applies the rules for multiplying decimal numbers to determine the product.

Student Action: Calculating the product, correctly placing the decimal in the product, and showing his work.

A: 17.568
B: 11.508
C: 14.168

Performance Check A: On your paper, multiply 7.32 X 2.4.

Remediation: Inability to multiply decimal numbers is a very common problem with junior high and middle school students. Excursion 2 is remedially oriented and should be helpful to some students. However, giving a simple problem quiz each week for four or five weeks will also prove helpful and give the student both further practice and the incentive to master the fundamentals.

The student should not be held back from further activities in the core because of his failure with this objective. Rather, encourage him to apply the algorithms in the excursion to his math problems and go ahead.

01 Core 16

Adds decimal numbers.

The student applies the rules for adding decimal numbers to determine a sum.

Student Action: Calculating the sum and showing his work.
A: 13.06
B: 7.15
C: 14.49

Performance Check A: Add these three numbers on your paper. 4.35, 3.4, 5.31

Remediation: Inability to add decimal numbers is a very common problem with junior high and middle school students. Excursion 2 is remedially oriented and should be helpful to some students. However, giving a simple problem quiz each week for four or five weeks will also prove helpful and give the student both further practice and the incentive to master the fundamentals.

The student should not be held back from further activities in the core because of his failure with this objective. Rather, encourage him to apply the algorithms in the excursion to his math problems and go ahead.

01 Core 17

Subtracts decimal numbers.

The student applies the rules for subtracting decimal numbers to determine the difference.

Student Action: Calculating the difference and showing his work.
A: 4.13
B: 2.02
C: 2.95

Performance Check A: Subtract 4.57 from 8.7 on your paper.

Remediation: Inability to subtract decimal numbers is a very common problem with junior high and middle school students. Excursion 2 is remedially oriented and should be helpful to some students. However, giving a simple problem quiz each week for four or five weeks will also prove helpful and give the student both further practice and the incentive to master the fundamentals.

The student should not be held back from further activities in the core because of his failure with this objective. Rather, encourage him to apply the algorithms in the excursion to his math problems and go ahead.

01 Core

Cleans up work area at close of class.

The student chooses to close the laboratory activity period promptly upon receiving notification of the time to do so.

Regular Supplies: As needed for regular ISCS activities.

18

Special Preparations: Use a few minutes of class time for group instruction early in the school year and as necessary for reinforcement to discuss the role of the student in the ISCS learning environment. To encourage personal responsibility in the student, discuss reasons for his closing his activities promptly (to allow time for himself and others for lab closing activities), returning materials to storage in clean condition (to facilitate their use by others), and participating in area cleanups (to leave the area as clean as he found it).

Student Action: Ceasing the ongoing laboratory activity when notified of the time, returning materials in usable, clean condition to storage, and participating in work area cleanup, on at least three separate occasions when being observed without his knowledge.

Teacher's Note: The opportunity for assessment of this objective arises almost every day during the course of regularly assigned laboratory activities.

Performance Check A: Your teacher will observe you for this check when he can.

Remediation: (1) If a student fails to accept this responsibility, approach him individually and review the reasons for his acceptance of it. Emphasize the social responsibility for cooperation in the learning environment for the good of all students. Point out that he has received the benefit of other students' provisions for others as well as for themselves. (2) Do not, at first, suggest that he may lose his privileges unless he cooperates. But if he doesn't cooperate after you observe his behavior several times, ask him if he can suggest a proper penalty. (3) An alternate remedy may be to request him to assist in the process of overall classroom accounting of the materials for a period of time until he recognizes the importance of the student's role. (4) Do not use extra cleanup as a penalty for not cleaning up properly. In other words, don't use something as a penalty that you want done willingly.

01
Core
19

Cooperates with lab partners.

The student chooses to cooperate with fellow students in the laboratory.

Special Preparation: Use a few minutes of class time at the beginning of a session for a whole group discussion early in the school year and several times later on to discuss the need for cooperation with and consideration of other students. Some particular points for discussion include being polite, waiting patiently, not making others wait longer than necessary, being orderly when moving about, and observing the right of others not to be disturbed. Talk about each student's accepting the personal responsibility for his own behavior in the group situation.

Student Action: Being polite, waiting his turn, being orderly when moving about, and observing the right of his classmates to work without being unnecessarily disturbed, when observed without his knowledge by the teacher or another designated person on at least three occasions.

Teacher's Note: The opportunity for assessing this objective arises almost every day during the course of regularly assigned laboratory activities.

Performance Check A: Your teacher will observe you for this check when he can.

Remediation: (1) If a student fails to accept any of these responsibilities, approach him privately and review the reasons for his lack of cooperation with his fellow students and suggest that he pay some attention to changing his behavior to more acceptable standards. (2) Find out if the student feels he is behaving in a less than acceptable way and if so, ask him whether he feels some penalty should be imposed and what a suitable penalty would be.

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01 Core 20

Returns equipment promptly to storage areas.

The student chooses to show personal responsibility for returning laboratory equipment no longer needed promptly to the proper storage places during the class period, not just at the end of the period.

Regular Supplies: As needed for regular ISCS activities.

Special Preparations: Use a few minutes of class time for group discussions of the reasons for returning equipment promptly to storage areas when it is not being used by the student or is not needed by his group. The reasons include (1) the short supply of certain items and the need to cooperate with others, (2) the chances of equipment being misplaced, (3) the possibility of accidental damage to equipment, and (4) pilferage by an irresponsible student.

Student Action: Returning equipment and materials no longer needed to the proper storage places on at least three occasions when observed by the teacher or another designated observer without knowledge of being checked.

Teacher's Note: This objective may be assessed at any time the student is responsible for learning activities requiring the use of equipment and supplies.

Performance Check A: Your teacher will observe you for this check when he can.

Remediation: In a private conference, discuss the reasons for the student's cooperation in this request. Ask for that cooperation. See also Remediations (1), (2), and (3) for 01-Core-18.

01

Responds to text questions.

The student chooses to write his answers in his *Student Record Book* to 90% or more of the textbook questions.

Core 21

Special Preparations: Use a few minutes of class time for group discussions of the reasons for writing the answers in the *Student Record Book*. Writing in the *Record Book* serves (1) to help the student think through what he sees and does, (2) to preserve ideas for future reference, (3) to make a record of the student's progress through the core, (4) to provide the teacher with a source of input for analyzing the student's difficulties and progress, and (5) to help the student learn the background ideas for conceptual understanding. Writing in the *Record Book* is "in"; writing in the text is "out."

Student Action: Exhibiting the written responses when requested to do so. At least nine out of ten questions should have responses, be they correct or incorrect.

Teacher's Note: It is intended that this objective be assessed throughout the year, not just at a formal unit assessment period. Such a check provides opportunities to encourage students to work nearer their capacities while remaining independent of the teacher.

Performance Check A: Your teacher will observe you for this check when he can.

Remediation: (1) In a private conference, discuss with the student the enumerated ideas and ask why he chooses not to write the answer. (Perhaps he cannot write!) Evaluate his reasons and counsel him accordingly. Encourage him to follow the pattern of his classmates and set down his ideas as they are doing. (2) Have the student read "Notes to the Student," pages xvii through xix in the text. (3) Follow up in a few days to determine his actions.

01
Core 22

Shows care for laboratory materials.

The student chooses to show proper care and use of ISCS laboratory materials.

Special Preparations: Use a few minutes of class time for whole group discussion of the reasons for handling laboratory materials properly. Such reasons include:

1. They are yours to use, since your parents pay for them.
2. They cannot readily be replaced. Replacement usually takes several months at best.
3. If damaged, they are lost to use by students who need them now. Short supply means waiting in line.
4. If materials are handled properly, they may be used for other than regular activities (with the permission of the teacher and after making a proper request).

Student Action: Using the materials only for their intended purpose or requesting permission to do other specific experiments with them, when being observed without his knowledge by the teacher or another designated person on three or more occasions.

Teacher's Note: This objective may be assessed at any time that the student is responsible for his own learning activity and equipment and supplies are required.

Performance Check A: Your teacher will observe you for this check when he can.

Remediation: (1) In a private conference, ask the student why he chooses to mishandle equipment. Help him to evaluate his reasons, and ask for his cooperation in the future. If he agrees, reassess the objective later. (2) If after the conference he still does not agree, ask him if he feels that he should be penalized and what he thinks would be an appropriate penalty. Give him another opportunity for compliance. (3) If he is still uncooperative, apply a penalty for mishandling equipment. This may mean denying him use of the equipment either temporarily or permanently, or taking some other suitable action.

01
Exc
01
1

Recognizes advantages of the metric system.

The student recalls that it is advantageous to use the metric system in science because its units are related by factors of 10 and therefore changing from one unit to another is relatively simple.

Student Action: Selecting the response to that effect.

A: c
B: b
C: a

Performance Check A: Which of the following tells the main advantage of the metric system which makes it useful in measurement problems?

a. It was developed in France, and most of the early scientists were French.
b. The meter has a more logical historical basis than the yard.
c. The units of the metric system are related by factors of the number ten, and therefore changing from one unit to another is easier.
d. All systems of measurement are of equal value, but scientists needed a common system of units. They happened to choose the metric system.

Remediation: (1) Have the student study page 279, Excursion 1. (2) Reassessment of the student later in the year with an alternate check after he has had the advantage of working with the decimal system for some time may result in mastery of this objective.

01
Exc
01

Selects the system of measurement used in ISCS.

The student identifies the metric system of measurement as the system used in the ISCS course.

Student Action: Selecting the response "metric system."

A: d
B: b
C: a

2

Performance Check A: The measurement system used in ISCS science is the

- a. Hebrew system.
- b. English system.
- c. Russian system.
- d. Metric system.

Remediation: (1) Have the student study page 279, Excursion 1. (2) Reassessment later in the year will give many students the advantage of having used the metric system and may result in successful achievement of the objective.

01
Exc
03
1

Distinguishes between direct and inferred comparisons.

The student classifies the example of direct comparison as that example in which the two factors are allowed to oppose one another directly.

Student Action: Selecting the appropriate example of direct comparison.

A: b
B: b
C: a

Performance Check A: In Excursion 3, you studied two forces – lift and drag – acting on two sinkers. One force was greater than the other. You found this by making the two forces act directly on each other. Read the two examples below. Which one directly compares the two variables?

- a. Mary ran around the school track. John ran around the block. Who can run faster?
- b. John and Mary raced each other around the school track. Who can run faster?

Remediation: (1) Have the student study page 291, Excursion 3, to find out what a direct comparison is. (2) Reassess learning with an alternate performance check. (3) After the student has done Unit 3, you may wish to reassess learning with the third alternate performance check to determine his mastery of the objective.

02

Chapters 3 and 4

Excursions 4 thru 8

Performance Check

Summary Table

Objective Number	Objective Description
02-Core-1	Selects examples of operational definitions
02-Core-2	Explains the need for standard units for measurement
02-Core-3	Remembers how to change the range of a force measurer
02-Core-4	Measures weight with a force measurer
02-Core-5	Determines the difference between the weights of two objects
02-Core-6	Recognizes unequal masses by examining their weights
02-Core-7	Plots coordinates and draws a line on a grid
02-Core-8	Defines *weight* operationally
02-Core-9	Reads a force measurer correctly
02-Core-10	Uses a force measurer correctly
02-Core-11	Names the metric unit of force used in ISCS
02-Core-12	Describes the kinds of change force produces on objects
02-Core-13	Explains magnetic attraction in terms of force
02-Core-14	Recognizes the greater force by the change it produces
02-Core-15	Uses characteristics of operational definitions to define *force*
02-Core-16	Remembers the questions that operational definitions answer
02-Core-17	Names the force acting on a force measurer
02-Core-18	Names the force acting to change the shape of an object

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
				Q		✓				applies	
						✓				applies	
				Q		✓				applies	
	M		P	Q	T	✓				manipulates	
	M		P	Q	T	✓				applies	
							✓		✓	applies	
			P		T	✓				applies	
									✓	generates	
	M		P	Q		✓				manipulates	
	M	O	P		T	✓				manipulates	
				Q		✓				recalls	
				Q		✓				applies	
	M				T					applies	
				Q		✓				classifies	
						✓				applies	
						✓				recalls	
				Q		✓				classifies	
				Q		✓				classifies	

02

Objective Number	Objective Description
02-Core-19	Recognizes the difficulty of operationally defining abstract terms
02-Core-20	Recognizes that a part is missing on measuring instruments
02-Core-21	Measures a force as the difference between two combined force readings
02-Core-22	Selects situations exhibiting forces other than gravity or friction
02-Core-23	Remembers characteristics of a standard for measurement
02-Core-24	Selects the better measuring instrument
02-Exc 06-1	Recognizes the advantages of subdividing units into tenths
02-Exc 06-2	Selects the scale that can be read with the greatest accuracy
02-Exc 06-3	Reads scales in decimal units
02-Exc 07-1	Knows man's role in making standards for measurement
02-Exc 07-2	Knows why standard units are used in preference to body-length units
02-Exc 08-1	Interprets a graph of inverse relationships
01-Core-9R	Measures length in centimeters
01-Core-11R	Selects advantages of using data tables
01-Core-12R	Locates specified data in a table
01-Core-13R	Selects a characteristic included in an operational definition
01-Core-14 thru 17R	(Arithmetic skills)
01-Core-18 thru 22R	(Student's responsibilities)

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
									√	applies	
				Q		√				applies	
	M				T			√	√	applies	
				Q		√				classifies	
				Q		√				recalls	
				Q		√				applies	
							√		√	applies	
						√				applies	
				Q		√				applies	
				Q						recalls	
						√				recalls	
				Q				√	√	applies	
	M			Q		√				manipulates	
				Q					√	recalls	
				Q		√				applies	
				Q		√				recalls	
				Q		√				applies	
	M	O		Q		√				chooses	

02 Core 1

Selects examples of operational definitions.

The student applies the concept that a definition is operational if it includes methods of detection and measurement.

Student Action: Selecting the operational definition.

- **A:** b only
- **B:** c only
- **C:** b only

Performance Check A: Which of the following is an operational definition?

a. A ruler is a device for measuring length.

b. Light is the form of energy which causes the needle of a light meter to move. The amount of needle movement measures the intensity of the light.

c. Mass is the amount of matter in an object and does not vary from place to place.

Remediation: (1) Does the student know what an operational definition is? Assess 02-Core-16. See the remediation there as a first step, if needed. (2) Ask him what an operational definition is. Then see if he can identify the one in the item he missed. Then show him why each of the distractors is not an operational definition and why the correct answer is. (3) Reassess the objective with an alternate performance check, or ask the student to reassess Self-Evaluation Check 3-4.

02 Core 2

Explains the need for standard units for measurement.

The student applies to the proposed use of washer units for measurement in ISCS the concept that the use of standard units of measurement by everyone facilitates the communication of data.

Student Action: Stating that the use of washer units will cause a problem and explaining that the use of standard units of measurement facilitates the communication of data.

Performance Check A: Suppose that throughout the course everyone in your class used his own force measurer scale marked in washer units.

1. Would this cause a problem?
2. Explain your answer.

Remediation: (1) Suggest that the student study page 29 (bottom) through page 30, question 3-33. (2) Then ask how he could be sure that students wherever they live would get the same force measurer reading if they measured the weight of an ISCS object. (3) Ask the student to reassess Self-Evaluation Checks 3-7 and 3-8.

Remembers how to change the range of a force measurer.

02 Core 3

The student applies the concept that the range of an instrument can be extended by altering those features which affect its sensitivity and precision.

Student Action: Selecting the entries to the effect that he would need a scale calibrated in smaller units and a thinner blade.

- **A:** a and c and no others
- **B:** b and c and no others
- **C:** a and d and no others

Performance Check A: Suppose you wanted to use your force measurer to find the weight of a small feather. List the letters of all of the following things that you would need for your force measurer.

a. A blade thinner than the thin blade you already have
b. A thicker than the thin blade, but thinner than the thick blade
c. A scale calibrated in units from 0 N to 0.1 N
d. A longer scale card

Remediation: (1) Have the student restudy page 38 (bottom) to find out what adjustments he had to make in the force measurer to weigh a 0.5 kg mass. (2) Ask him what alterations he would have to make to weigh a feather. Would he have to change two parts?

Measures weight with a force measurer.

02 Core 4

The student manipulates a force measurer to determine the weight in newtons of two objects.

Regular Supplies:		
	1 ISCS force measurer	1 newton scale card
	2 blades (one thick, one thin)	paper clips

Special Preparations: Prepare sets of objects to be weighed as follows:

- **A:** 1 spinigig disk and 1 skate wheel
- **B:** 1 spinigig disk and 1 electricity measurer base
- **C:** 1 skate wheel and 1 electricity measurer base

Weigh the objects separately and determine the range of acceptable responses for each. Dispense sets as required by the students.

Student Action: Reporting the weights of the objects to within 0.05 newton of the value determined by the teacher.

Performance Check A: Get an ISCS force measurer, 2 blades, paper clips, and a newton scale card from the supply area. From your teacher, get a spinigig disk and a skate wheel. Report to your teacher how much the spinigig disk weighs and how much the skate wheel weighs.

Remediation: This skill includes the skills of objectives 02-Core-10 and 02-Core-3 as basic to the student's understanding. If he misses this assessment, determine where his difficulty originates. (This determination probably should be made by personal observation.) Selecting a blade and the matching scale, zeroing the scale card, reading the blade position accurately, and translating the blade's position to scale card units are all essential skills of equal importance. Discuss these with the student; then provide some objects for him to weigh as practice. Reassess the objective with an alternate check or with Self-Evaluation Check 3-10 b.

---

02 Core 5

Determines the difference between the weights of two objects.

The student applies appropriate procedures of manipulating a force measurer to weigh each of two objects and of calculating the difference between the two weights.

Regular Supplies:	1 ISCS force measurer and blades	newton scale card
	1 aluminum cup	paper clips

Special Preparations: Prepare sets of objects in boxes as follows:

Box 02-Core-5A: "D" cell battery and a roller skate wheel
Box 02-Core-5B: "D" cell battery and an ISCS sinker
Box 02-Core-5C: Roller skate wheel and an ISCS sinker

Determine the weights and the differences in weights for each pair of objects in each box and record the differences under "Student Action" on the appropriate line for each performance check.

Student Action: Stating the difference in newtons to within 10% of the value determined by the teacher.

A: ______ newtons
B: ______ newtons
C: ______ newtons

Performance Check A: Get two objects from box 02-Core-5A. Use an ISCS force measurer, an aluminum cup, paper clips, and a newton scale card to weigh each of the two objects. Write the difference in newtons between the weights.

Remediation: (1) Basic to this objective are objectives 02-Core-4 and 02-Core-10. See the remediations for them and apply as needed to correct the student's deficiencies. (2) Also basic to this objective is the mathematical term *difference* and the student's understanding of it. If you said "subtract," he would know to find the difference between two measurements. (3) If computation of the difference is the difficulty, then practice of this skill is needed as suggested for objective 01-Core-17. (4) Reassess this objective with an alternate performance check as needed.

02

Recognizes unequal masses by examining their weights.

The student applies the concept that uniformly increasing the number of equal masses will uniformly increase the total weight of the group.

Student Action: Responding to the effect that the weights of the objects are not uniform.

Core 6

Performance Check A: John brought his own washers from home to weigh on his force measurer. He added one washer at a time to a hook on the end of the force measurer blade. He made the data table shown below.

Number of Washers on Hook	Weight of Washers (in newtons)
1	0.8
2	1.4
3	2.4
4	2.6
5	2.8
6	3.4

What do you conclude about the weights of the washers John brought from home?

Remediation: (1) Ask the student to use the data table to find out the exact weight of each object weighed. (He can do this easily by subtraction.) This will show him how to get more out of the table than is at first apparent. (2) Have him then compare the weights of the individual objects. (3) Ask if all the objects had the same weights. (4) Refer the student to pages 28 and 29 in the text.

Plots coordinates and draws a line on a grid.

O2 Core 7

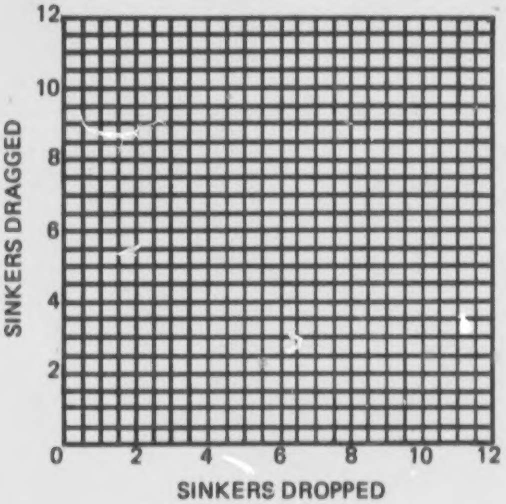
The student applies the procedure for plotting data and drawing a best-fit line on a grid.

Special Preparations: You will need to have graph paper available in order to use this item. You may wish to ditto or mimeograph copies of the grid below with the labels already on it. In that case, all the student is required to do is to plot the points and draw the best-fit line correctly, which is the intent of the objective.

Student Action: Constructing a graph of the data in which each point lies in a straight line and drawing a best-fit line (which in this ideal case would, if extended, pass through the origin).

Performance Check A: Larry did Excursion 3, which compares weight and drag. On a separate piece of graph paper, label the axes as shown below. Then construct a graph of Larry's data, which are listed in the table below. The table shows the dragging power of the dropping sinkers. Draw a best-fit line for the plotted points.

Sinkers Dropped	Sinkers Dragged
2	3
4	6
6	9
8	12



Remediation: (1) Assign Excursion 5 to the student. Check his responses. Discuss whether or not he knows his deficiency in this objective. (2) Ask him to reassess his response to Self-Evaluation Check 3-3. (3) Reassess with an alternate performance check as needed.

02 Core 8

Defines *weight* operationally.

The student generates the operational definition that weight deflects a force measurer blade when an object is hung on it and is measured by the amount the blade is deflected.

Student Action: Responding in his own words both (1) that weight is what causes a force measurer blade to deflect downward and (2) that the amount the blade is deflected is a measure of the amount of weight.

Performance Check A: Write an operational definition for *weight*, using an ISCS force measurer in your definition.

Remediation: (1) Does the student know what an operational definition is? Assess 02-Core-16. See the remediation there as a first step if it is relevant. (2) Does he know that weight is the response of an object to gravity? Have him study page 27, the last three paragraphs, and page 28, questions 3-25 and 3-26. (3) A discussion of defining *force* operationally is found on pages 23 and 24. Relate this to weight as a force. (4) Ask the student if he could tell whether or not the force of weight was acting on a force measurer blade. (5) Reassess this objective or use the related objective, 02-Core-15.

02 Core 9

Reads a force measurer correctly.

The student manipulates the force measurer to make a correct reading on the scale.

Special Preparations: No advance preparations need be made until a student requests a force measurer. However, if you have three spare force measurers, you may wish to set up the equipment in advance, as follows. Zero the force measurers in the vertical position, using a thin blade on one measurer and a thick blade on the other two. Tape the appropriate newton scale cards to the force measurers when they are properly zeroed. Bend the blades and insert a pin in any one of the three holes. Release the blades gently. Hole 3 should not be used with the thin blade, as the resultant reading is off the scale.

Student Action: Reporting (1) whether the blade is thin or thick, (2) the hole the pin is in, and (3) the force on the pin to within the limits below.

Thin blade:	hole 1	0.51 to 0.55	Thick blade:	hole 1	4.6 to 5.0
	hole 2	0.80 to 0.84		hole 2	7.1 to 7.5
	hole 3	Not to be used		hole 3	9.6 to 10.0

Performance Check A: Ask your teacher for a force measurer with an aluminum pin in it. Do not remove the pin.

Answer the following questions by listing the numbers (1, 2, and 3) on your paper and writing after each number the answer to the corresponding question.

1. Does the force measurer have the thin or thick blade attached to it?
2. What is the number of the hole the pin is in?
3. How much force is on the aluminum pin?

Remediation: Skills basic to this objective include finding the position of the blade at which to make the scale reading and interpreting that position accurately in decimal units. (1) Place the pin in another hole after deflecting the blade to the extreme position. Release the blade and ask the student to read the measurement. Watch to see if he aligns the flat of the blade and looks across it to the scale, or if he holds it and looks at some other angle. Correct him if necessary. (2) If his difficulty is reading the scale at the proper point, assign Excursion 6 and assess the objective with 02-Exc 06-3.

---

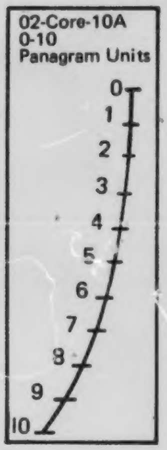
02 Core 10

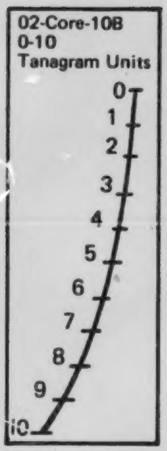
Uses a force measurer correctly.

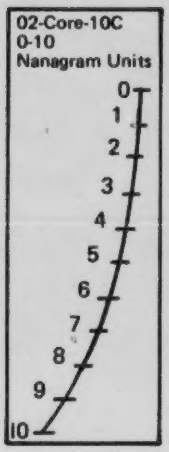
The student manipulates a force measurer scale card to zero it before weighing an object on the force measurer.

Regular Supplies:	1 force measurer	1 hook
	1 thin blade	1 sinker

Special Preparations: Using blank force measurer cards, prepare each of three scale cards with equal but nonstandard units as shown on the next page.







Student Action: Adjusting the scale card to zero it with the blade before weighing the object.

Teacher's Note: An observer is required. The student's verbal or written response to the question asked is not relevant to the performance evaluated for this objective. He is required only to zero the card before using it.

Performance Check A: From your teacher, get force measurer scale card 02-Core-10A. Use your force measurer with the thin blade to weigh a sinker. Have your teacher watch you. Report the weight in the units shown on the scale card.

Remediation: (1) Discuss the reason for zeroing the blade to be sure the student understands that this is necessary in order to get an accurate force reading. (2) Have the student study the last paragraph of page 29. (3) Have the student zero the card for a vertical measurement of weight. Then lay the force measurer flat on its back and have him observe whether or not the blade is still zeroed. Ask if he should always be sure the card is zeroed. (4) Reassess the objective with an alternate performance check several days later. (5) See the Remediation for 02-Core-5.

02 Core 11

Names the metric unit of force used in ISCS.

The student recalls *newton* as the metric term used in ISCS to measure force.

Student Action: Stating the term *newton*.

Performance Check A: Write on your paper the name of the metric unit you use in ISCS to measure force.

Remediation: (1) Have the student review pages 35 and 36 and his responses to the questions. (2) Ask him to check his response to Self-Evaluation question 4-5. (3) Reassess the objective at a later time.

---

02 Core 12

Describes the kinds of change force produces on objects.

The student applies the concept that a force changes one or more of the following: (1) an object's shape, (2) its rate of motion, (3) the direction of its motion.

Student Action: Responding to the effect that he would look for any two of the following:

(1) a change in the object's shape
(2) a change in the object's rate of motion
(3) a change in the direction of the object's motion

Performance Check A: Suppose you want to know when a force is acting on a football. Write on your paper two kinds of changes you would look for.

Remediation: (1) Ask the student to review his responses to the questions on pages 21 and 22. Go over them with him. (2) Check his response to Self-Evaluation question 3-1. After a discussion of ways to tell if a force is acting on an object, ask him for an oral definition of *force*.

---

02 Core 13

Explains magnetic attraction in terms of force.

The student applies the concept that a force changes either the motion or the shape of an object, or both.

Regular Supplies:	1 compass	1 force measurer blade
	1 nail	1 heavy washer

Student Action: Responding that a force is acting and citing as evidence the motions of the compass needle or a change in its direction (analogous to a change in shape).

Performance Check A: Get a compass and a nail from the supply area. Set the compass on your desk. Bring the nail very near to the compass from three different directions. Watch what happens.

1. Is there a force acting between the nail and the compass?
2. How do you know?

Remediation: (1) Basic to this objective is the student's understanding of the results of applied forces. The use of objective 02-Core-12 is suggested to diagnose the deficiency. Its remediation is recommended there. (2) A discussion accompanying the activity in the check he missed should reinforce his concept of a force acting.

02

Recognizes the greater force by the change it produces.

The student classifies the greater of two forces as the one producing the greater amount of change in the shape of the object being acted upon.

Core 14

Student Action: Selecting the diagram that shows the greater deformation and stating that a greater force produces a greater change.

A: Diagram a
B: Diagram b
C: Diagram a

Performance Check A:

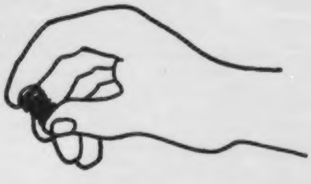


Diagram a

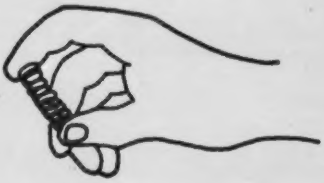


Diagram b

The two springs being squeezed by the hands are alike.

1. Which diagram shows the greater amount of force being applied?
2. Explain the reason for your choice.

Remediation: The student must recognize (1) that a change has taken place in the natural shape of the body in question, (2) that there is a difference in the amount of change shown in the two diagrams, and (3) that this difference is measurable by comparison of the two amounts of change. Ask him to explain what causes one object to be deformed more than the other. (4) Reassess, using an alternate performance check.

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02 Core 15

Uses characteristics of operational definitions to define *force.*

The student applies the characteristics of operational definitions to define *force.*

Student Action: Responding to the effect that a force can be detected by observing the change in shape or motion that it causes in an object and can be measured by determining the amount of change.

Performance Check A: An operational definition answers two questions. Write an operational definition for *force* in which you answer those two questions.

Remediation: (1) Does the student know what an operational definition is? Assess 02-Core-16. See the remediation there as a first step, if needed. (2) Does he know what is referred to by the word *force*? For a definition and discussion read pages 19 through 22 in the text. (3) A discussion of defining *force* operationally is included on pages 22 through 24. (4) Self-Evaluation question 3-1 should provide the student with the ideas for an operational definition of *force.* (5) Reassess the objective.

02 Core 16

Remembers the questions that operational definitions answer.

The student recalls that an operational definition of an entity answers the questions about the entity, "How do I know I have some?" and "How do I know how much I have?"

Student Action: Responding in his own words with the equivalents of (1) How do I know when I have some? and (2) How do I know how much I have?

Teacher's Note: This concept grows slowly in the minds of many students. This growth can be accelerated by the teacher's making sure that the self-evaluation problems and text questions are both answered and, if necessary, corrected. Reviewing the concept several times helps to fix the idea in the student's mind.

Performance Check A: Write on your paper the two questions you would have to answer about something if you wanted to write an operational definition for it.

Remediation: (1) Have the student study the text, pages 22 through 24, and his responses to the text and self-evaluation questions. (2) After he has done that, ask him this question orally. (3) If he still fails, have him discuss the question with his laboratory partners or another student. (4) Reassess the objective.

02 Core 17

Names the force acting on a force measurer.

The student classifies the type of force exerted by objects suspended from a force measurer.

Student Action: Responding with either the term *weight* or the term *gravity*.

Performance Check A: Two sinkers are attached to the blade of a force measurer, and the blade bends down. Name the force that is pulling on the blade.

Remediation: (1) Have the student study page 27 and question 3-25, page 28. (2) Review the results of applying a force to an object and relate these to the change in shape of the force measurer blade. (3) Ask the student for another name for "heaviness." Ask what happens when a heavy object is hung on a force measurer. (4) Reassess the objective with an alternate performance check.

02 Core 18

Names the force acting to change the shape of an object.

The student classifies weight as the force acting in a specified situation.

Student Action: Responding either that weight or that gravity is the force acting. (See the Remediation if the student responds with "gravity.")

Performance Check A: John sat on a chair. After a minute, the chair legs gave way and John ended up on the floor. What force caused a change in the shape of the chair?

Remediation: If the student's response is "gravity," tell him that he is right, but be sure he sees that "weight" is another way of saying the same thing. If he does not appear to see this, proceed with the Remediation outlined in 02-Core-17.

02 Core 19

Recognizes the difficulty of operationally defining abstract terms.

The student applies the concepts that the characteristics of these abstract qualities are (1) variable and (2) difficult to detect or quantify, in order to explain why abstract terms do not lend themselves to being operationally defined.

Student Action: Stating in his own words that (1) the characteristics of *love, honor,* and *beauty* are not generally agreed upon and (2) there is no satisfactory method of detecting them or measuring them. (Mentioning either detection or measurement should be counted as correct.)

Performance Check A: State two reasons why it is difficult to define operationally such terms as *love* or *beauty.*

Remediation: (1) Determine if he knows the definition of *operational definition.* (See 02-Core-16 and its remediation.) (2) See if he can give you an operational definition for *love.* Can he be sure everyone has the same definition? Point out the difficulty of saying exactly what *love* is. (3) Explore the following two questions with him: "Can *love* be measured? How?"

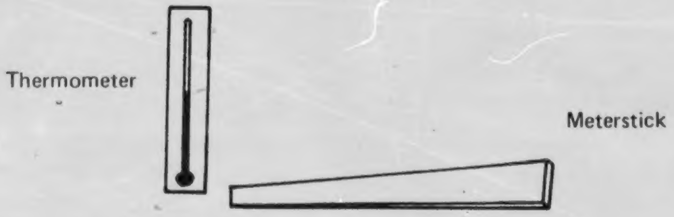
02 Core 20

Recognizes that a part is missing on measuring instruments.

The student applies the concept that most common measuring instruments have scales which facilitate the communication of measurement.

Student Action: Stating that the instruments need scales.

Performance Check A: Look at the diagrams of measuring instruments. What needs to be added to them so that you could tell your teacher your measurement without having to show him the thermometer or the meterstick?



Remediation: (1) Hand the student a blank thermometer stem and ask him to measure the temperature of a container of water. His reply can be turned into a discussion of the objective he missed. (2) Give the student a force measurer and an object to weigh, but no scale card. Ask him to weigh the object with no further equipment. As above, his reply can be used in a discussion of the objective.

Measures a force as the difference between two combined force readings.

02
Core
21

The student applies procedures for measuring a force as the difference between two combined forces [magnetic force = (combined weight + magnetic force) - (combined weight force)].

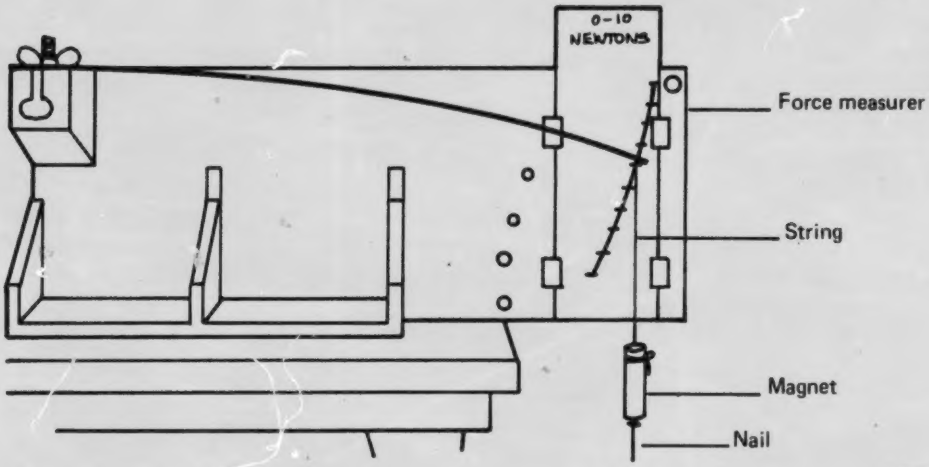
Regular Supplies:

1 force measurer	1 6d nail
1 thick blade	1 flat-headed screw
1 magnet	1 thumbtack
string	1 0-10 newton scale card

Student Action: Measuring forces and reporting step 3 as the difference between steps 2 and 1 as he reported them. (The value the student gets is not critical, but his procedure is.)

Performance Check A: Tie or tape a magnet to a string, as shown below. Hang the magnet on the thick force measurer blade. Measure the combined weight of the magnet and string. Number and record your results for each step of the following.

1. Record the combined weight of the magnet and string.
2. Attach a nail to the magnet as shown. Pull gently on the nail until the magnet releases it. What is the force measurer reading when the magnet releases the nail?
3. How much force did the magnet exert on the nail?



Remediation: (1) See Objective 02-Core-5 and its Remediation. (2) Point out that before the metal object is brought near the magnet, the force measurer reading indicates the combined weight of the magnet and string. At the time the magnet breaks away from the object, the force measurer reading is the greatest and includes the combined weight of the magnet and string plus the magnetic force. (3) This objective can be reassessed after remediation with an alternate performance check.

02 Core 22

Selects situations exhibiting forces other than gravity or friction.

The student classifies the situations which have a force acting in addition to gravity or friction.

Student Action: Selecting choices involving ongoing change of motion.

A: b, d, and e
B: a, b, and c
C: b, c, and e

Performance Check A: List the letters of the situations described below in which there is a force acting in addition to gravity and friction.

a. A motorcycle parked in a garage
b. A stone smashing through a window
c. A sinker sitting on a shelf
d. Two football players hitting head-on
e. A washer lifted from a desk

Remediation: The student must know how to tell (a) whether a force is acting and (b) whether or not that force is something other than either gravity or friction.

(1) In a discussion of the examples in the performance check, give him an opportunity to identify changes that occur because a force is acting (02-Core-12). (2) Discuss these changes in terms of the force that causes them. Eliminate those examples caused by gravity or friction. (3) Discuss the kinds of forces that cause the other changes. (4) Reassess the objective with an alternate performance check as needed.

02 Core 23

Remembers characteristics of a standard for measurement.

The student recalls that to be a standard for measurement, an object must be (1) uniform over time, (2) easy to duplicate, (3) agreed upon, (4) of a convenient size, and (5) readily available.

Student Action: Responding with the effect of at least three of these: (1) uniform over time, (2) easy to duplicate, (3) agreed upon, (4) of a convenient size, and (5) readily available.

Performance Check A: List four things which should be true of an object if it is to be used as a standard unit of measurement.

Remediation: (1) Have the student review pages 31 through 33 in the textbook and his answers to the questions, and make a list of the characteristics of standard calibration objects. (2) Look at his list, and ask him about each characteristic. What does it mean to him? (3) If he has not found them all, help him complete the list. (4) Ask him to check his response to Self-Evaluation question 3-8.

Selects the better measuring instrument.

02
Core
24

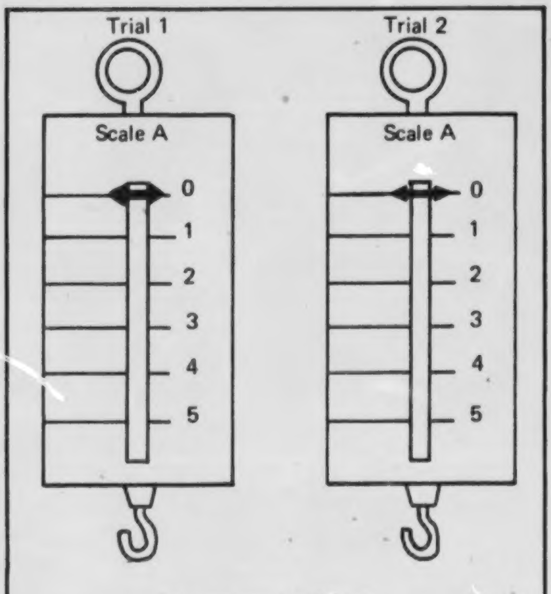
The student applies the concepts, in selecting a scale for use, that a good measuring instrument has a stable reference point and reproducible equal unit intervals.

Student Action: Selecting the correct scale and stating in effect that (1) it has a stable reference point and (2) the unit intervals are regularly spaced.

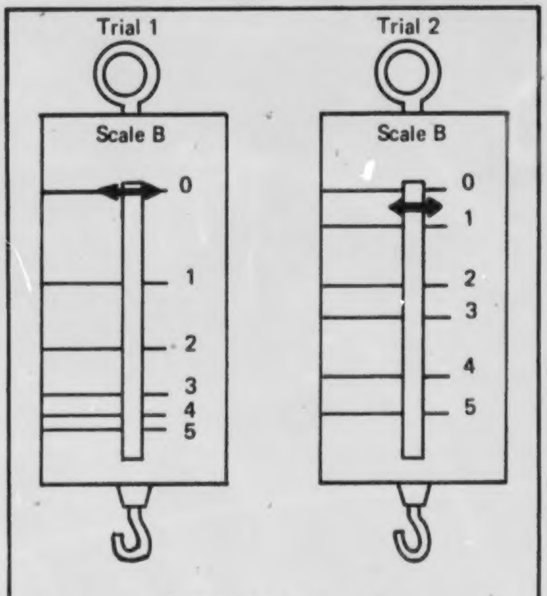
- **A:** Scale A
- **B:** Scale B
- **C:** Scale A

Performance Check A: Sol was given two old and uncalibrated spring scales, A and B. He calibrated each spring scale two times. The two drawings below show the results of his calibrations for each scale. Sol must use one of these two scales in an experiment.

1. Which spring scale should he use?
2. Why?



Calibrations for Scale A



Calibrations for Scale B

Remediation: (1) Ask the student to find two differences in the calibrations for scale B (calibration points changed, zero changed). (2) Ask why he thinks these differences occurred. (3) Ask if he thinks he could depend on such a scale. (4) Ask if scale A had those problems.

02 Exc 06 1

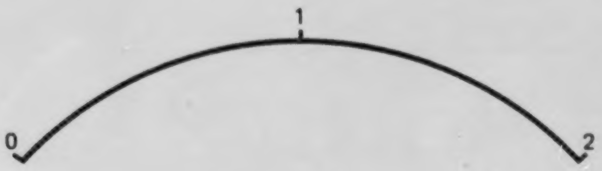
Recognizes the advantages of subdividing units into tenths.

The student applies the concept that subdividing a unit into ten equal parts makes reporting and using the measurements easier than any other subdivision because of our decimal number system.

Student Action: Responding to the effect that ten subunits are easiest, because of our decimal number system, both to use in math computation and to report.

Performance Check A: In this course you often make several measurements which you are then asked to multiply and divide. Suppose you were to use the scale below.

1. Would it be easiest to report, multiply, and divide the measurements if the units on the scale were divided into 9, into 10, or into 11 subunits?
2. Why?



Remediation: (1) Ask the student to solve this problem: John measured the length of his pencil with three rulers. The first ruler (A) was divided so that each inch had nine parts, and the pencil measured 7 5/9 inches. The second ruler (B) had ten parts per inch, and the pencil measured 7 5/10, which, of course, is 7.5 inches. The third ruler (C) had eleven parts per inch, and the pencil measured 7 6/11 inches. John wants to cut the pencil into three equal parts. How long should each part be as measured by each ruler? (A: 2 14/27 inches, B: 2.5 inches, C: 2 17/33 inches.) (2) Then ask which ruler yielded measurements which would be easiest to use, and why. The second ruler should be used because the pencil can be divided easily into three 2.5 inch segments. (3) Study page 309, Excursion 6. (4) Reassess, using an alternate performance check.

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02 Exc 06

Selects the scale that can be read with the greatest accuracy.

The student applies the concept that the more subdivisions there are on a scale, the more precise are the readings that can be made with it.

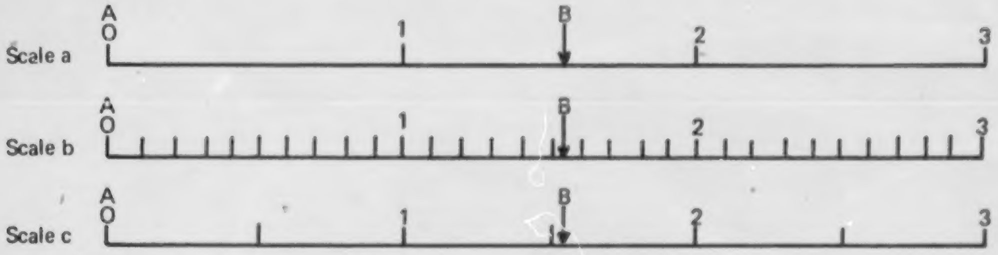
Student Action: Selecting the 1/10 scale and stating in effect that more subdivisions make scale readings more precise.

A: Scale b
B: Scale a
C: Scale c

Performance Check A:

2

1. From which of the three scales below could you report the most accurate measurement of the distance from A to B?
2. Why?



Remediation: (1) Give the student a scrap of paper 2 3/8" long and ask him to report its length as measured on each of the three scales in the check he used. (2) Ask him which measurement he feels is most accurate and why he thinks so. (3) If his response is unsatisfactory, look at his response to question 6-16 in Excursion 6 and discuss this. (4) Reassess the objective with an alternate performance check another day.

Reads scales in decimal units.

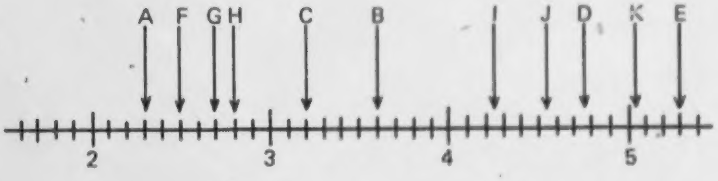
O2
Exc
O6
3

The student applies the process of reading scales in decimal form.

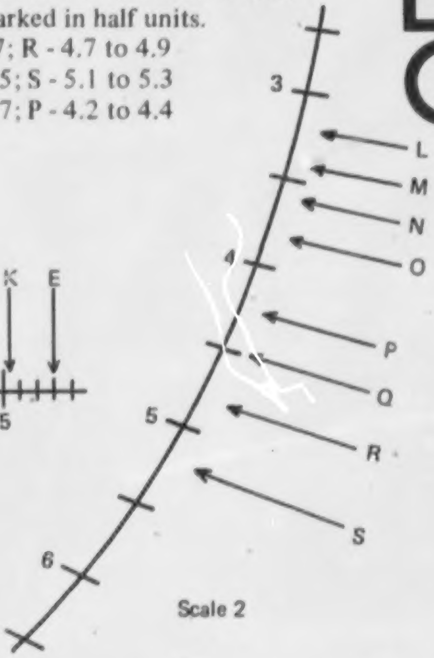
Student Action: Reporting designated readings to within ± .05 units on a scale marked in tenth units and to within ±.1 units on a scale marked in half units.

A: H - 2.75 to 2.85; I - 4.20 to 4.30; N - 3.5 to 3.7; R - 4.7 to 4.9
B: F - 2.45 to 2.55; D - 4.72 to 4.82; M - 3.3 to 3.5; S - 5.1 to 5.3
C: H - 2.75 to 2.85; K - 5.00 to 5.10; N - 3.5 to 3.7; P - 4.2 to 4.4

Performance Check A:



Scale 1



Scale 2

Report your answers to both questions below in decimals.

1. On scale 1, what is the reading at H? At I?
2. On scale 2, what is the reading at N? At R?

Remediation: (1) Give the student the same performance check he has worked on, but ask him to give you the readings orally. Try to determine whether it's practice he needs or remediation in the basic procedure of making a reading on the scale. (2) Assign remedial work accordingly. (3) When you are satisfied that he's ready, reassess the objective with an alternate performance check.

---

02 Exc 07 1

Knows man's role in making standards for measurement.

The student recalls that the size of a unit of measurement is a matter of definition by man.

Student Action: Selecting the one entry which indicates that the size of the unit is defined by man.

A: d
B: a
C: c

Performance Check A: Write the letter of the best answer. When the size of a unit of measurement such as the meter was first determined, it was

a. discovered by scientists.
b. taken from a list of standards passed down through the years.
c. naturally set by something in nature.
d. set by a group of men who agreed on its size.

Remediation: Have the student restudy Excursion 7 and answer these questions: "Who fixed the length of the yard? What government set up the metric system of measurement? In your answers to those questions, were the standards set by men, nature, or God?"

---

02 Exc 07 2

Knows why standard units are used in preference to body-length units.

The student recalls that measurement units based on body lengths vary, whereas standard units always have the same value.

Student Action: Responding in effect that (1) the values of body-length measurements vary and (2) the values of standard units do not vary.

Performance Check A: The *palm* is a unit of length based on the width of a man's hand. The *digit* is a unit of length based on the width of a man's index finger.

1. Why aren't measurement units such as the palm and digit used very much today?
2. Why are standard units such as the meter and the gram used instead?

Remediation: (1) Have the student restudy page 316, Excursion 7, and answer the questions: "Why aren't parts of the body good standards for measurement? Why are standard units based on such things as the iron ulna and the meter more dependable?" (2) Reassess with an alternate performance check another day.

02
Exc
08
1

Interprets a graph of inverse relationships.

The student applies the rules for interpreting regions of large and small changes of inversely related variables.

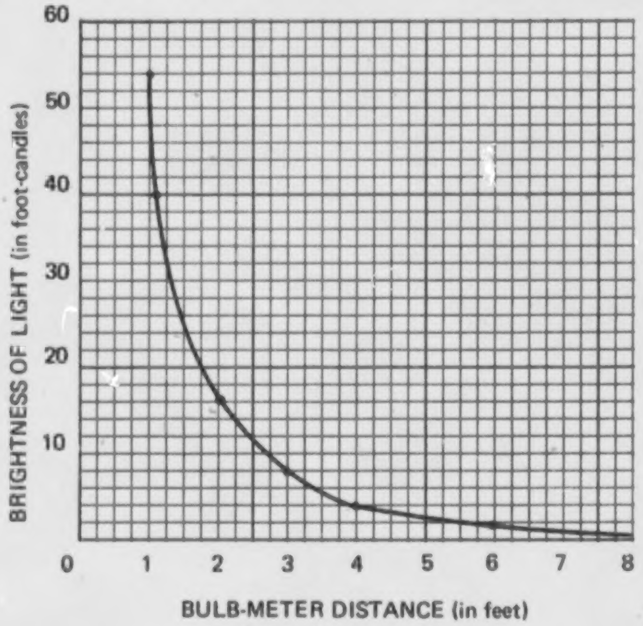
Student Action: Selecting the word option to conform with the rule above.

- **A:** 1. large, 2. small
- **B:** 1. large, 2. small
- **C:** 1. large, 2. small

Performance Check A: The brightness of a lighted bulb was measured with a light meter at several distances from the bulb. The data were graphed as shown below. Notice that the light brightness decreases as the distance increases.

Compare the change in brightness between the distances of 1 foot and 2 feet with the change between 4 feet and 8 feet. Choose the words which correctly complete the following two sentences.

1. When the bulb and meter are close together, a small change in distance produces a (large) (small) change in brightness.
2. When the meter and bulb are far apart, a large change in distance produces a (large) (small) change in brightness.



Remediation: (1) In a conference with the student, try to make it simpler for him to see the relationship by asking him (a) to record the change in brightness shown on the graph for the change in distance from 1 foot to 2 feet and (b) to record the change shown for the change in distance from 4 feet to 8 feet. Then ask which change is greater. Ask whether the greater change occurs when the meter is close to the bulb or far away. (2) Ask the student to check his answer to Self-Evaluation question 3-12. (3) Reassess the objective another day.

03

Chapters 5 thru 7

Excursions 9 thru 14

Performance Check

Summary Table

Objective Number	Objective Description
03-Core-1	Recognizes the relationship between work done and the method of doing it
03-Core-2	Measures short distances in meters
03-Core-3	Converts quantities from one metric unit to another
03-Core-4	Names the metric unit for measuring work
03-Core-5	Measures work done
03-Core-6	Defines *work* operationally
03-Core-7	Names the process of applying a force over a distance
03-Core-8	Selects the quantities used in calculating work
03-Core-9	Matches the terms *system, subsystem*, and *component* to their definitions
03-Core-10	Lists components which make up a subsystem.
03-Core-11	Selects diagrams of systems and defends his choices
03-Core-12	Selects subsystems of a system
03-Core-13	Recognizes the relationship between work and systems
03-Core-14	Selects input and output components
03-Core-15	Names the source of input work and the recipient of output work in a system
03-Core-16	Selects quantities and calculates input and output work
03-Core-17	Predicts the relative amount of input to output work on a balance in a system
03-Core-18	Averages three decimal numbers

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
				Q		✓				applies	
	M			Q		✓				manipulates	
				Q		✓				applies	
				Q		✓				recalls	
	M		P	Q	T	✓				applies	
						✓				recalls	
				Q		✓				classifies	
				Q		✓				applies	
				Q		✓				classifies	
				Q		✓				applies	
				Q					✓	applies	
									✓	applies	
				Q		✓				classifies	
				Q		✓				classifies	
				Q		✓				classifies	
				Q	T		✓		✓	applies	
				Q					✓	applies	
				Q		✓				applies	

O3

Objective Number	Objective Description
03-Core-19	Recognizes the value of averaging measurements
03-Core-20	Explains variations in repeated measurements
03-Core-21	Predicts data from a graph
03-Core-22	Names the force resisting sliding objects
03-Core-23	Remembers why output work is less than input work
03-Core-24	Remembers the cause of the heating of sliding surfaces
03-Core-25	Predicts the effect on friction of adding weight to a sliding object
03-Core-26	Recognizes the error of having two independent variables in an experiment
03-Core-27	Names constant and varying variables in similar situations
03-Core-28	Selects the variables not held constant
03-Core-29	Names variables to be controlled in an experiment
03-Exc 09-1	Recognizes the distance-force relationships of a single movable pulley
03-Exc 10-1	States the effects of pulley use on input and output forces, distances, and work
03-Exc 11-1	Recognizes the effect of slope on the force needed to slide objects up an incline
03-Exc 12-1	Determines moments and the direction of motion
03-Exc 13-1	Computes the average of mixed numbers
03-Exc 14-1	Recognizes the constancy of weight friction on a rectangular object
01-Core-3R	Recognizes variables as changing or affecting activities

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
						✓				applies	
						✓				applies	
	M		P	Q	T		✓			applies	
				Q		✓				classifies	
						✓				recalls	
				Q		✓				applies	
				Q		✓				applies	
								✓		applies	
				Q				✓	✓	classifies	
				Q				✓	✓	classifies	
				Q					✓	applies	
				Q					✓	applies	
									✓	recalls	
										applies	
				Q	T				✓	applies	
				Q	T		✓			applies	
				Q					✓	applies	
				Q		✓				classifies	

03

Objective Number	Objective Description
01-Core-6R	Explains applications of influence output in terms of influence input
01-Core-7R	Matches terms *system, subsystem*, and *component* to definitions
01-Core-11R	Selects advantages of using data tables
01-Core-14 thru 17R	(Arithmetic skills)
01-Core-18 thru 22R	(Student's responsibilities)
02-Core-7R	Plots coordinates and draws a line on a grid
02-Core-10R	Uses a force measurer correctly
02-Core-12R	Describes the kinds of change force produces on objects
02-Core-16R	Remembers the questions that operational definitions answer

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
						√				applies	
				Q		√				classifies	
				Q		√				recalls	
				Q		√				applies	
	M	O		Q		√				chooses	
			P		T	√				applies	
	M	O	P		T	√				manipulates	
				Q		√				applies	
						√				recalls	

03 Core 1

Recognizes the relationship between work done and the method of doing it.

The student applies the concept that the amount of work done on an object is independent of the method of accomplishment.

Student Action: Selecting the entry which indicates that the same amount of work is done regardless of the method of accomplishment.

A: d
B: a
C: b

Performance Check A: How can you lift a 40 lb box from the floor to the table with the least amount of work being done on the box? Select the best answer below.

a. Lift it with your hands.
b. Push it up an inclined plane.
c. Use a pulley and a rope.
d. Any way you do it, the work on the box is the same.

Remediation: (1) Check Table 5-4 in the *Student Record Book* to see if the student's answers are nearly equal in all three cases. If so, determine whether the student has thought this through before. The text discusses this on pages 49 and 50. The concept is diametrically opposed to some students' intuitive grasp of the idea. Many students may need to be led to an understanding of it. Hopefully most will accept the idea. (2) Self-Evaluation Checks 5-4 and 6-7 deal with the same concept. You may wish to review the student's responses to them.

03 Core 2

Measures short distances in meters.

The student manipulates a metric ruler to measure distances in metric units between pairs of specified points.

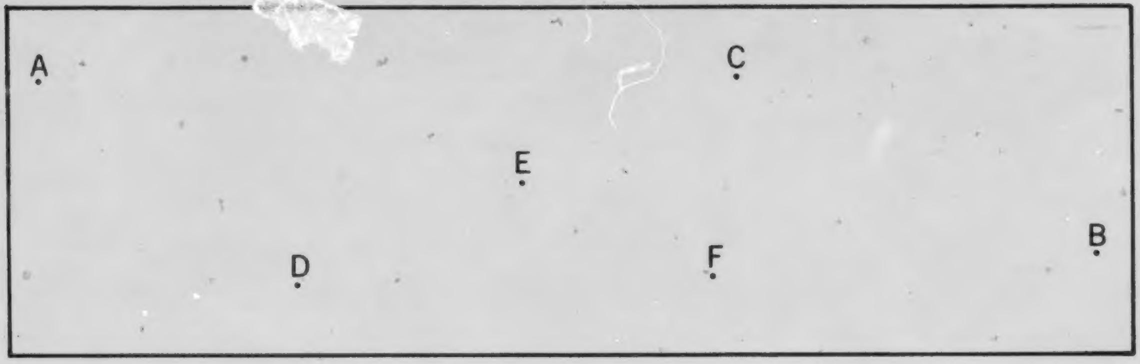
Regular Supplies: 1 metric ruler or meterstick calibrated in centimeters

Student Action: Measuring and reporting the distance between the specified points to ±0.005 meter in all the three cases.

A: A to B – 0.152 to 0.162 m; C to D – 0.066 to 0.076 m; E to F – 0.026 to 0.036 m
B: B to C – 0.054 to 0.064 m; D to E – 0.031 to 0.041 m; A to E – 0.067 to 0.077 m
C: A to D – 0.043 to 0.053 m; D to F – 0.056 to 0.066 m; B to F – 0.051 to 0.061 m

Performance Check A: Measure the distance between each of the three pairs of points, and record your answers in meters.

1. A to B
2. C to D
3. E to F



Remediation: (1) Can the student use a meterstick to measure? See Objective 01-Core-9 and the Remediation for it. (2) Can he convert cm to m and m to cm? If not, then: (a) point out the conversion units in the middle of page 280 (Excursion 1), (b) teach him how multiplying a measurement by the conversion factor changes the unit of the measurement, and (c) give him a couple of practice conversions to make from cm to m. (3) If the student has difficulty in rounding off numbers to the nearest 0.01 m, refer him to Excursion 2, page 285.

---

03 Core 3

Converts quantities from one metric unit to another.

The student applies the rule that there is a conversion factor of 100 units between one meter and one centimeter.

Student Action: Moving the decimal point two places to the left to convert centimeters to meters and two places to the right to convert meters to centimeters in at least three of four cases. One error is allowed.

A: 0.07 m; 70 cm; 0.32 m; 420 cm
B: 380 cm; 90 cm; 0.75 m; 0.08 m
C: 290 cm; 0.72 m; 0.08 m; 410 cm

Performance Check A: Make the changes asked for in each of the following cases.

1. 7 cm = ___ m
2. 0.7 m = ___ cm
3. 32 cm = ___ m
4. 4.2 m = ___ cm

Remediation: (1) Point out the conversion units in the middle of page 280 (Excursion 1). (2) Teach the student that multiplying a measurement by the conversion factor changes the unit of the measurement. (3) Give him a few conversions to make both from cm to m and from m to cm, or ask him to reevaluate his responses to Self-Evaluation Check 6-2.

03

Names the metric unit for measuring work.

The student recalls the unit *newton-meter* as the standard metric unit used in ISCS

Core 4

for measuring work.

Student Action: Naming the unit *newton-meter.*

Performance Check A: What is the metric unit used in ISCS for measuring work?

Remediation: Textbook references to the unit *newton-meter* are found on pages 51, 52, 61, and 63.

---

03 Core 5

Measures work done.

The student applies the concept that work is the product of a force and the distance through which it is applied.

Regular Supplies:		
	1 force measurer	1 spinigig
	1 electricity measurer base	1 cart

Special Preparations: Since desk heights and equipment weights vary from school to school, it is necessary for you to perform the activity in each item and calculate the tolerance for each answer. An electricity measurer base is used in 03-Core-5A, a spinigig in 03-Core-5B, and an ISCS cart in 03-Core-5C. Record your answers in this book in the space provided under Student Action.

Student Action: Measuring the distance lifted and the force used, calculating the work done, and reporting the final result to within a tolerance range of 5% of the value obtained by the teacher.

A:
B:
C:

Performance Check A: Find out how much work is done when you lift an electricity measurer base from the floor to your desk top. Get the equipment you need to do this. Record your measurements in newtons and meters, and record the answer in the correct units.

Remediation: (1) Ask what must be done to measure work. Does he know what measurements are needed? See 03-Core-7 and 03-Core-8. (2) Did he successfully make these measurements? See 03-Core-2 and 03-Core-3 for distance measurement diagnosis. See 02-Core-4, 02-Core-9, and 02-Core-10 for force measurement diagnosis. (3) If his error lay in multiplication of the quantities, see the Remediation for 01-Core-14.

03

Defines *work* operationally.

The student recalls that *work* is operationally defined as the product of a force and the distance through which it is applied.

Student Action: Responding to the effect that work is the product of a force times

Core 6

the distance through which the force is applied. Also acceptable, though less detailed, is the answer that work is the product of force times distance.

Performance Check A: Write an operational definition for *work*.

Remediation: (1) Check the student's response to question 5-18 in his *Student Record Book*. Discuss his response with him. (2) Does he recognize what an operational definition is? If he doesn't, see the Remediations for 01-Core-13 and 02-Core-16. (3) Have the student study pages 51 through 53 in the text and tell you how he figured the work in Table 5-5. You might want to assess objective 03-Core-7, or ask the student to reevaluate his response to Self-Evaluation Check 5-3.

---

03 Core 7

Names the process of applying a force over a distance.

The student classifies a situation involving the process of exerting a force over a distance as involving work.

Student Action: Stating the term *work*.

Performance Check A: Complete the sentence below.

Helen lifted the cart from the floor and put it on the table. Her science classmates said she was doing ___ on the cart.

Remediation: (1) Have the student review pages 50 through 53 in the text and his response to question 5-18. (2) Ask him how to measure influence. See if he can then substitute *work* for *influence* in his vocabulary. (3) Return to the item he missed, and find if he knows what measurable quantities (force and distance) are represented in the item. (4) Then ask for the term that describes moving something by exerting a force over a distance.

---

03 Core 8

Selects the quantities used in calculating work.

The student applies the rule that force and distance are the only quantities that apply to the direct calculation of the amount of work done on an object.

Student Action: Selecting measurements of the applied force and the distance the object is moved.

A: b and d
B: b and c
C: a and b

Performance Check A: A force measurer was used to pull a box across the floor. What measurements below would you use to measure the work done on the box? Choose as many as are needed. Do not calculate the work.

a. The box moved for 80 seconds.
b. The box moved 100 cm.
c. The speed of the box was 1.25 cm per second.
d. The box required 8 newtons of force to be moved.

Remediation: (1) If the student selected the speed entry or the time entry, have him study pages 51 and 52 and tell you why he should not have made that selection. (2) Ask if he now knows the entries needed. (3) If further definition of the terms used in calculating work is needed, see 03-Core-6.

03 Core 9

Matches the terms *system, subsystem,* and *component* to their definitions.

The student classifies definitions for the terms *system, subsystem,* and *component (of a system).*

Student Action: Matching the terms *system, subsystem,* and *component (of a system)* with their respective definitions.

A: 1. e, 2. c, 3. b
B: 1. c, 2. d, 3. a
C: 1. d, 2. c, 3. e

Performance Check A: Match the terms *system, subsystem,* and *component* with their definitions. Write the number of the term and the letter of the matching definition on your answer sheet.

Terms	Definitions
1. System	a. A person who fights another
2. Subsystem	b. An object that is part of a system
3. Component (of a system)	c. A group of objects that interact directly within a system
	d. A group of objects, such as a hat, a book, a feather, and a clod of dirt
	e. A group of objects that interact with each other

Remediation: (1) See the Remediation for 01-Core-7. Have the student review the discussion in Chapter 1 and on page 59 in Chapter 6. (2) Check his understanding with a performance check from 01-Core-7, or ask to reevaluate his response to Self-Evaluation Check 6-12.

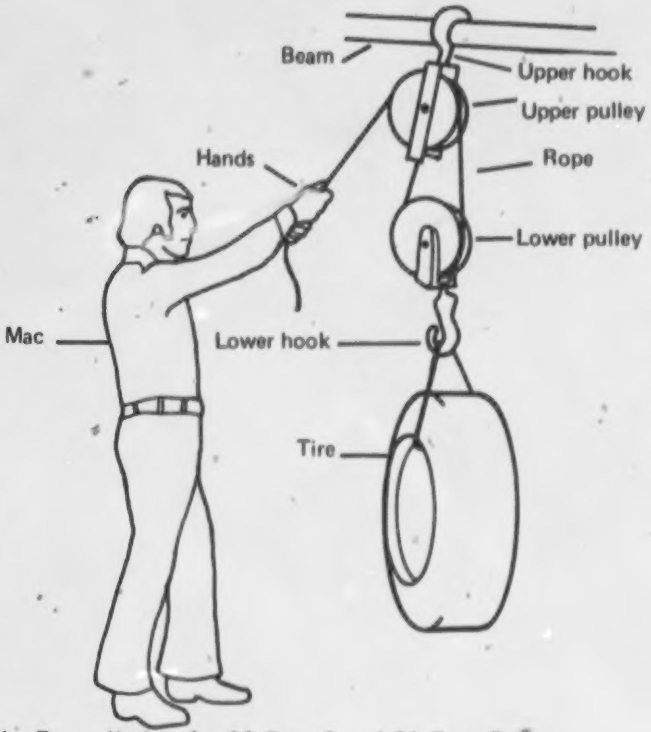
03 Core 10

Lists components which make up a subsystem.

The student applies the definition that a component of a subsystem is any one of a set of objects which directly influence each other.

Student Action: Listing any four parts of the system which directly influence each other.

Performance Check A: Mac uses the system shown to lift heavy truck tires. List four labeled components which form a subsystem in Mac's system.



Remediation: See the Remediation for 03-Core-9 and 01-Core-7.

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03 Core 11

Selects diagrams of systems and defends his choices.

The student applies the definition that a system is a group of objects that interact with each other.

Student Action: Selecting the two diagrams which represent systems and stating the effect of the definition that a system is a group of objects that interact with each other.

- **A:** Diagrams a and b
- **B:** Diagrams b and c
- **C:** Diagrams a and c

Performance Check A: Study the diagrams below.

1. List the letter of each diagram which shows a single system.
2. Explain why any diagrams you chose represent systems.

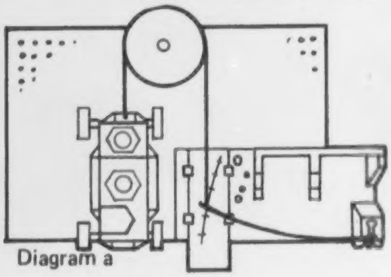


Diagram a

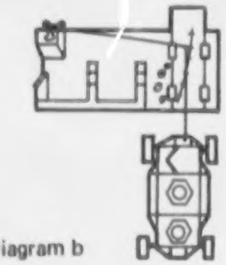


Diagram b

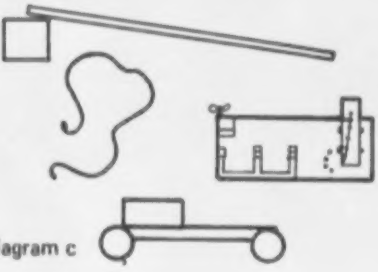


Diagram c

Remediation: See the Remediations for 01-Core-7 and 03-Core-9.

03 Core 12

Selects subsystems of a system.

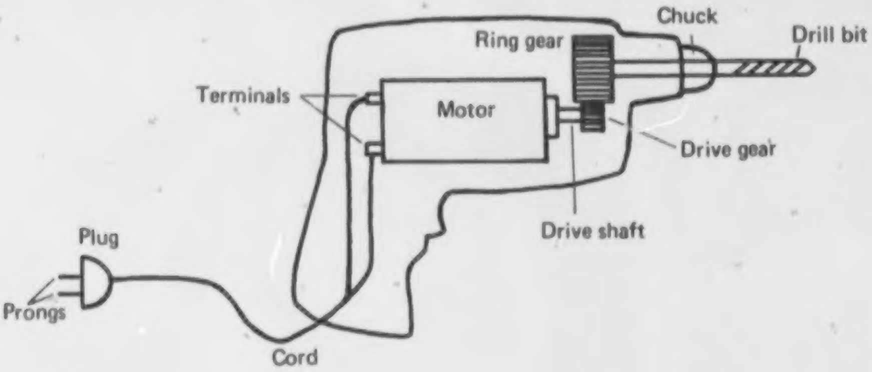
The student applies the concept that subsystems are sets of components in a system which interact with each other directly.

Student Action: Indicating the sets of components which constitute subsystems and stating the notion that subsystems are sets of components that interact directly with each other.

A: c and d
B: a and c
C: b and e

Performance Check A: Study the diagram of the electric drill.

1. List each of the sets of components listed below which can be considered a subsystem.
2. Explain why you selected the sets you did.



Components

a. plug, motor, chuck
b. prongs
c. motor, drive shaft, drive gear
d. ring gear, chuck, drill bit
e. prongs, cord, drive shaft

Remediation: See the Remediations for 01-Core-7 and 03-Core-9.

03 Core 13

Recognizes the relationship between work and systems.

The student classifies the work-related characteristics of systems.

Student Action: Selecting the phrases "transfer input work" and "use input work to do useful work" and no others.

A: b and c
B: b and d
C: a and d

Performance Check A: Select the phrases which describe the relationship between work and systems. A system can

a. be its own source of input work.
b. transfer input work.
c. use input work to do useful work.
d. operate with no input work.

Remediation: See 01-Core-7, 03-Core-9, 03-Core-11, and 03-Core-18.

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03 Core 14

Selects input and output components.

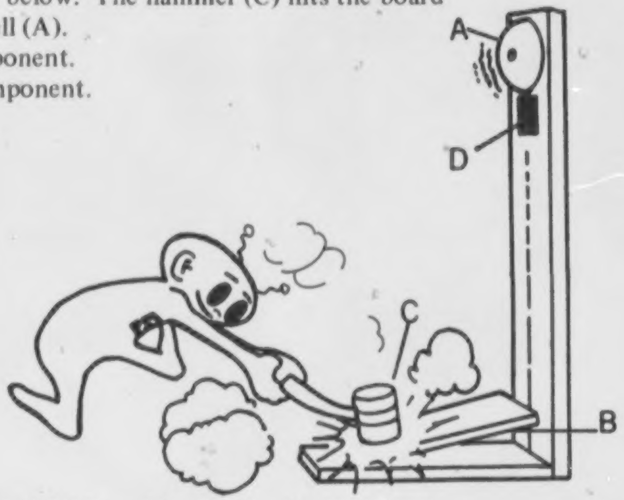
The student classifies components in specified systems as input and output components.

Student Action: Selecting the input and output components.

A: 1. C, 2. A
B: 1. B, 2. C
C: 1. D, 2. A

Performance Check A: Look at the diagram below. The hammer (C) hits the board (B) and drives the weight (D) up to hit the bell (A).

1. Select the letter of the input component.
2. Select the letter of the output component.



Remediation: (1) See 01-Core-7, 03-Core-9, and 03-Core-12. (2) For input and output components, refer to the text, pages 59 through 61, and (3) review the student's responses to the questions on those pages.

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03 Core

Names the source of input work and the recipient of output work in a system.

The student classifies what is doing work on a specified system as the input source and what the system is doing work on as the output recipient.

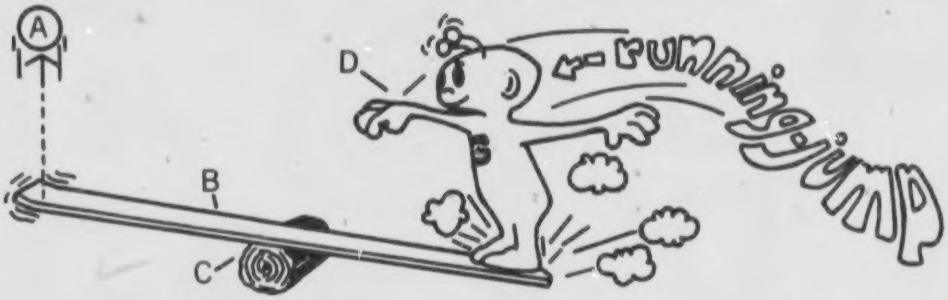
Student Action: Indicating the input source and output receiver.

A: 1. D, 2. A
B: 1. D, 2. A
C: 1. C, 2. D

15

Performance Check A: In the diagram, consider that the ball (A), the balance board (B), the log (C), and Iggy (D) make up a system. After the appropriate numbers, write the letter that identifies the source of the input work in the system and the letter that identifies the object on which the output work is done.

1. The input work is done in the system by ___.
2. The output work done by the system is done on ___.



Remediation: (1) See 03-Core-14 to determine the student's ability to define and identify input and output components. (2) Refer to page 59 in the text for definitions of *input* and *output* work. (3) Review the student's responses to questions 6-8 through 6-17.

---

03 Core 16

Selects quantities and calculates input and output work.

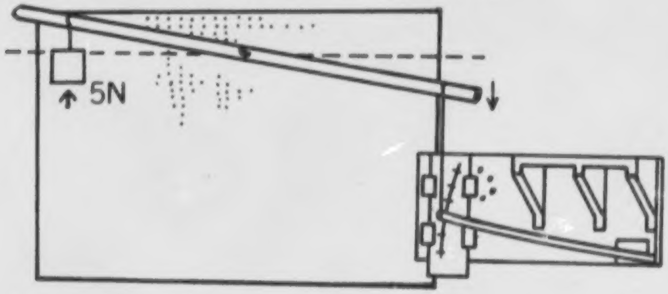
The student applies the concepts that input work is work done on a system, output work is work done by a system, and that the work done is equal to the amount of force multiplied by the distance over which the force acts.

Student Action: Reporting the input and output work done.

A: 1. 0.75 N·m, 2. 0.65 N·m
B: 1. 1.6 N·m, 2. 1.4 N·m
C: 1. 1.08 N·m, 2. 0.92 N·m
(Any answers within ±0.1 newton-meter of the above are acceptable.)

Performance Check A: In the diagram below, think of the balance arm as a system. The force measurer shows a reading of 3 N and was moved down 0.25 m. The 5 N weight moved up 0.13 m.

1. How much input work was done in the system?
2. How much output work did the system do?



Remediation: (1) See 03-Core-8 for the ability to select the proper quantities for calculating work. (2) See 03-Core-15 and 03-Core-14 for the ability to define and identify *input* and *output work* and *components.* (3) See 01-Core-14 if the student's arithmetical calculation is faulty.

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03 Core 17

Predicts the relative amount of input to output work on a balance in a system.

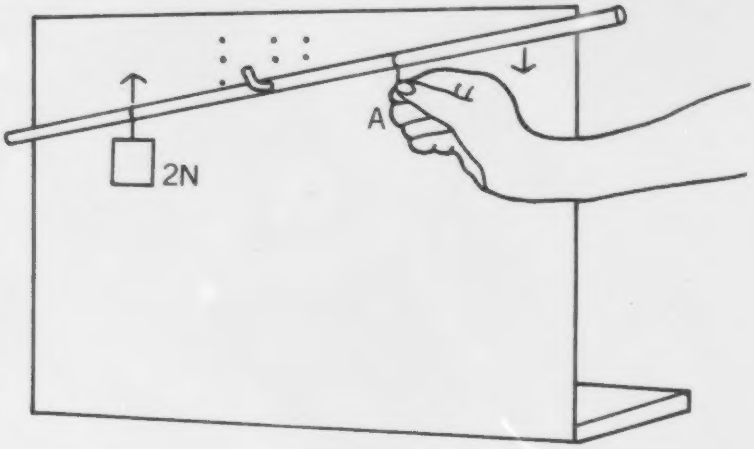
The student applies the concepts that input work is always greater than output work and that work equals force times distance.

Student Action: Selecting the response which indicates the input work to be just a little bit greater than the output work.

A: c
B: d
C: a

Performance Check A: Look at the diagram of an equal-arm balance below. Ji pulled hook A, lifting the 2 N weight 0.4 m. He wondered how much input work he had done on the system. What is the best answer that you could give him?

a. Just a little bit less than 0.8 N·m
b. Exactly 0.8 N·m
c. Just a little bit more than 0.8 N·m
d. It is impossible to say, since no force or distance measurements were made of the input work of the system.



Remediation: (1) See 03-Core-15 for the ability to identify input work to and output work from a system. (2) See 03-Core-6 for the operational definition of *work*, work equals force times distance. (3) Refer to page 64 of the text for a discussion of the concept that friction makes output less than input.

O3 Core 18

Averages three decimal numbers.

The student applies mathematical procedures to find an average.

Student Action: Reporting the average of three decimal numbers within the range of ±0.1 for at least one of the two cases.

A: 1. 3.4 to 3.6, 2. 3.7 to 3.9
B: 1. 2.4 to 2.6, 2. 2.5 to 2.7
C: 1. 1.9 to 2.1, 2. 2.0 to 2.2

Performance Check A: Find the average of each of the following two sets of numbers. Show your work.

1. 2.3, 4.5, and 3.8
2. 4.1, 3.0, and 4.3

Remediation: (1) If the student misses one response but gets the other correct, give him credit, but check to see that his procedure is correct. (2) Excursion 13 is designed to teach this important process. You may want to refer him to it. (3) You can either reevaluate his performance with an alternate check or ask the student to check his answers to Self-Evaluation Check 7-1.

O3 Core 19

Recognizes the value of averaging measurements.

The student applies the concept that the average of several measurements is probably less in error than individual measurements because the variation between individual measurements is balanced in the calculation of the average.

Student Action: Responding to the effect that an average value is probably less in error because individual variations in measuring are balanced in the calculation of the average.

Performance Check A: George punched a hole in the bottom of a paper cup. He tried to count how many drops of water fell from the cup in one minute. His data from several trials are shown in the table below. Why is the average of 46 drops per minute probably closer to the actual count than the individual figures for the six trials?

Trial	Drops per Minute
1	44
2	47
3	45
4	48
5	47
6	45
Average	46

Remediation: (1) Review the last paragraph on page 357 in Excursion 13, and pages 71 and 75 in Chapter 7. (2) Be sure that the student understands the difference between errors in measurement which are unavoidable and mistakes which are caused by misreading of instruments.

---

03 Core 20

Explains variations in repeated measurements.

The student applies the concept that it is impossible to eliminate all errors in measurement.

Student Action: Responding to the effect that it is impossible to eliminate all errors in measurement.

Performance Check A: Six scientists measured the length of the same steel rod with the same meterstick. They got the following data.

Scientist	Length of Rod (in cm)
1	73.8
2	73.9
3	74.1
4	74.0
5	73.9
6	74.1

Why shouldn't they all expect to get the same measurement for the steel rod?

Remediation: (1) Suggest that the student read the material at the bottom of page 357 and answer questions 13-7 through 13-13 in Excursion 13. Alternatively, you may wish to suggest that he check his response to Self-Evaluation Check 7-3. (2) Ask the student to look back at Table 6-1 on page 63. Ask him the question, "Would repeating measurements of force and distance give exactly the same results?" If the student says "yes," ask him to try it and see.

---

03 Core 21

Predicts data from a graph.

The student applies the procedures for extrapolating and interpolating from a graph.

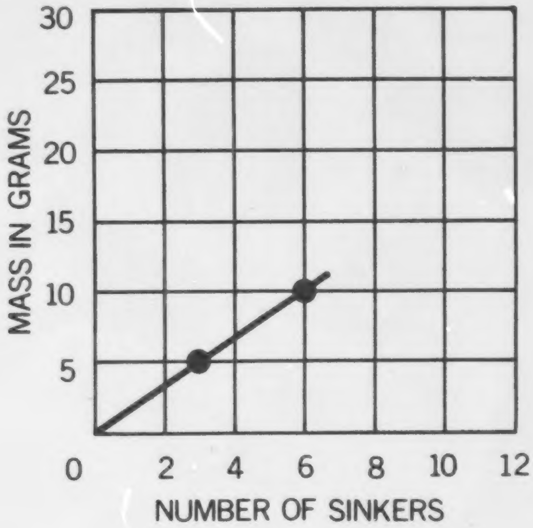
Special Preparation: You will need to have available either appropriate grid paper or duplicated graphs with axes labeled, points plotted, and line drawn as in the one below.

Student Action: Reporting extrapolated values for numbers 1 and 3, and interpolated values for numbers 2 and 4.

A: 1. 14.0 to 16.0 g, 2. 1.0 to 3.0 g, 3. 17.5 to 19.5 g, 4. 6.0 to 8.0 g
B: 1. 26.5 to 28.5 g, 2. 6.5 to 8.5 g, 3. 16.5 to 18.5 g, 4. 11.5 to 13.5 g
C: 1. 16.5 to 18.5 g, 2. 6.5 to 8.5 g, 3. 21.5 to 23.5 g, 4. 1.5 to 3.5 g

Performance Check A: Get from your teacher either a copy of the graph below or grid paper. (On grid paper, copy the graph below, label the axes, plot the points, and draw the line.) Using the graph, find the mass in grams of the following.

1. 9 sinkers
2. 1 sinker
3. 11 sinkers
4. 4 sinkers



Remediation: Assign Excursion 5. Check the student's response to question 5-8. Also discuss his responses to questions 7-17 and 7-18 in the text. Excursion 4 may be assigned if the student has trouble with graphing.

O3 Core 22

Names the force resisting sliding objects.

The student classifies friction as the force acting in situations involving sliding objects.

Student Action: Naming *friction* as the active force.

Performance Check A: Juan attached his force measurer to his science textbook. He then pulled the book across his desk. The force measurer reading as the book moved along was 9 newtons. What is the name of the force he was measuring?

Remediation: Have the student review pages 67 and 68 and his responses to questions 7-3 and 7-4.

O3
Core
23

Remembers why output work is less than input work.

The student recalls the concept that some input work is always used to overcome friction.

Student Action: Responding to the effect that some input work is required to overcome friction.

Performance Check A: Why is the amount of input work done on a system always greater than the useful output work?

Remediation: Review the text, page 64, and discuss the student's responses to questions 6-25, 6-26, and 6-27.

O3
Core
24

Remembers the cause of the heating of sliding surfaces.

The student applies the concept that sliding friction causes changes in the temperature of the surfaces involved.

Student Action: Responding that friction is the force responsible.

Performance Check A: When a drag racer leaves the starting line, its wheels spin vigorously and get hot. What force causes the tires to get hot?

Remediation: Review the text, pages 64 and 65, and the student's responses to the related questions.

O3
Core
25

Predicts the effect on friction of adding weight to a sliding object.

The student applies the concept that the force of friction of a sliding object varies directly with the weight added to the object.

Student Action: Predicting that the amount of friction force would increase.

Performance Check A: Think of an empty garbage can being dragged across a concrete drive. What would happen to the amount of friction if the can were filled with garbage?

Remediation: (1) Review with the student his responses to questions 7-6 and 7-7. (2) Review his responses to Table 7-1, and ask why the data in the "average" column indicates an increase in friction with the increase in the weight of the block and sinkers. (3) Apply to a new situation the notion that the weight of the sliding object is increased, and ask if the amount of friction remains the same, increases, or decreases.

O3

Recognizes the error of having two independent variables in an experiment.

The student applies the principle that there should be one and only one independent variable in an experiment.

Core 26

Student Action: Responding to the effect that there are too many variables which change for the experiment to be a good one. An experiment should have one and only one independent variable at a time.

Performance Check A: Mr. Smith wanted to determine which kind of grain grew best on his farm. He divided the farm into four sections, 1, 2, 3, and 4. He put a different kind of seed in each section. He also wanted to test whether fertilizer A or B was better for his soil. He put A on sections 1 and 3 and B on sections 2 and 4. What is wrong with Mr. Smith's experiment?

Remediation: (1) Review with the student his responses to the Daisy Dimwit example on pages 77 and 78 of the text. Ask him to name the things that varied. (2) Review the data from Table 7-3 in the text and ask the student to tell you about his answers to questions 7-25 and 7-26. (3) Then, see if the student can succeed with an alternate item from this objective or in answering Self-Evaluation Check 7-7.

---

03 Core 27

Names constant and varying variables in similar situations.

The student classifies a variable which is unchanged in two trials and a variable which changes in two trials.

Student Action: Listing in his own words one changing and one unchanging variable in the situations presented.

A: 1. Unchanged variables: a. the number dropped, b. the mass or weight dropped, c. the place dropped from, d. time of event
2. Changed variables: a. the landing surface, b. the distance dropped

B: 1. Unchanged variables: a. the distance dropped, b. the landing surface
2. Changed variables: a. the object dropped, b. the material of the objects, c. the weight of the objects

C: 1. Unchanged variables: a. the length of time of the activity, b. the time length of the counting period, c. place (track)
2. Changed variables: a. the persons checked, b. the sex of the persons, c. the degree of activity

Performance Check A: Jack did an activity in which he studied the bouncing of objects. He dropped two sinkers at the same time from shoulder height. One hit the floor; the other landed on a pile of three books.

1. Name a variable that is unchanged in both cases.
2. Name a variable that changes in the two cases.

Remediation: (1) See 01-Core-7 for developing the definition of *variable.* (2) *Constant variable* is defined on pages 73 and 76. *Controlled variable* is defined on pages 73 and 74. (3) Review the student's response to this performance check item. Have him criticize his response. (4) Reassess the objective with an alternate performance check.

03 Core 28

Selects the variables not held constant.

The student classifies the independent variable as the factor which is varied on purpose and the dependent variable as the factor which varies as a result.

Student Action: Naming both the dependent and independent variables.

- **A:** 1. the kind of cord material, 2. the distance before tires wear out
- **B:** 1. the three chemicals, 2. the number of bacteria destroyed
- **C:** 1. the four kinds of paint, 2. the amount of fading

Performance Check A: A car tire manufacturer wants to know which of three kinds of cord material – steel, fiberglass, or nylon – will help his tires give the best mileage.

1. What variable will he vary on purpose in his experiment?
2. After the manufacturer has made the changes proposed in part 1, what variable does he study the changes in?

Remediation: (1) For the definition of *variable*, see 01-Core-7. (2) A *constant variable* is defined on pages 73 and 76 of the text. A *controlled variable* is defined on pages 73 and 74. (3) Examples of a varying factor and a varied factor are found on pages 69 and 70. (4) Discuss his response to the performance check with the student.

03 Core 29

Names variables to be controlled in an experiment.

The student applies the concept that in experimental situations there are factors other than the independent variable whose variation must be controlled if the data are to be interpretable.

Student Action: Naming two of the following or similar factors requiring control in the specified situations.

- **A:** Track and track surface, kind of day, wind and weather conditions, tire condition, weight
- **B:** Kind of fuel, engine temperature, engine load (test usually run with wheels free to spin and having same tires, hub caps, etc., mounted on them)
- **C:** Engine tune-up, fuel, track temperature, track condition, same car, weather conditions

Performance Check A: A racing car owner wants to know which fuel will give his car the most speed. Naturally he will make the tests driving his own car. Name two other factors that he must keep unchanged if his trials are to be useful.

Remediation: (1) *Variable* is defined in 01-Core-7. (2) *Constant variable* is defined on pages 73 and 76. *Controlled variable* is defined on pages 73 and 74. (3) Examples of a controlled variable are found on pages 73 and 74. (4) Discuss his response to the performance check with the student.

O3 Exc O9 1

Recognizes the distance-force relationships of a single movable pulley.

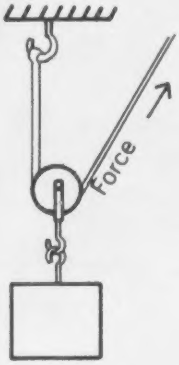
The student applies the concept that a movable pulley requires less force to move an object, but the force moves through a greater distance than the object moves.

Student Action: Selecting the one force and one distance listed in the given situations which are consistent with the concept.

A: 1. 20 cm, 2. 5 N
B: 1. 40 cm, 2. 10 N
C: 1. 80 cm, 2. 40 N

Performance Check A: In the pulley arrangement shown in the diagram below, the mass and the pulley together weigh 10 N and will be lifted 10 cm. Read the sentences which follow. Select the one quantity in parentheses which best completes each sentence, and record your answers.

1. To raise the mass and pulley 10 cm, the force would have to move (5, 10, 20) cm.
2. The amount of force required to raise the combined weight of 10 N of the mass and the pulley by pulling on the rope would be about (5, 10, 20) newtons.



Remediation: The student experimenting with movable pulleys is often baffled because the measurements he has made are counter to his intuitive understanding of the situation. (1) Check the data he recorded in Table 9-2, Excursion 9. (2) Compare his data in column 5 with that in column 2. It should be about one-half that in column 2. (3) Compare columns 3 and 5. The relation should be about 1 to 2. (4) If his data are faulty, have him repeat the data collection. (5) Reassess the objective with an alternate performance check.

O3

States the effects of movable pulley use on input and output forces, distances, and work.

The student recalls that the relationship of input work to output work in movable pulley systems is about equal and that the benefit of using them is that they act as multipliers of the input force – lifting heavy weights requires less pull.

Exc
10
1

Student Action: Responding to the effect that (1) input work on movable pulley systems is about equal to the output work (no work is saved) and (2) the benefit of pulley systems is that a person could lift heavier objects with the pulley system than otherwise.

Performance Check A: In Excursion 10, you worked with pulley systems using movable and fixed pulleys.

1. In movable pulley systems, how does the input work required to lift an object compare with the output work done on the object?
2. What is the main benefit of using movable pulleys to lift objects?

Remediation: (1) Review with the student his data in Excursion Table 10-2 and his response to question 10-3 in Excursion 10. (2) Discuss his response to question 9-5 in Excursion 9.

O3
Exc
11
1

Recognizes the effect of slope on the force needed to slide objects up an incline.

The student applies the concept that the force required to pull or push an object up an inclined plane decreases as the slant of the incline decreases.

Student Action: Indicating that the force required would be decreased and stating as the reason the notion that as the length of an inclined plane is increased, the force needed to move an object to a given height is decreased.

Performance Check A: Two men tried to load a roll of newsprint onto a truck. They tried to use a ten-foot long plank as an inclined plane. They didn't have enough force to roll the newsprint up the incline.

1. If the men got a twenty-foot long plank for an incline, would the force required to roll the newsprint onto the truck be decreased, increased, or not changed?
2. Why is this the case when a longer plank is used?

Remediation: (1) Review the student's graph, Figure 11-5, in his *Record Book*. Ask him to state the relationship between the variables studied as shown on the graph. (2) Have the student do Excursions 17 and 18 to learn more about the relationships shown by graphs. (3) Take another look at the graph, Figure 11-5, and again ask the student to state the relationship between the variables.

O3
Exc
12

Determines moments and the direction of motion.

The student applies the concept of differences between moments and the direction of motion for two unbalanced moments.

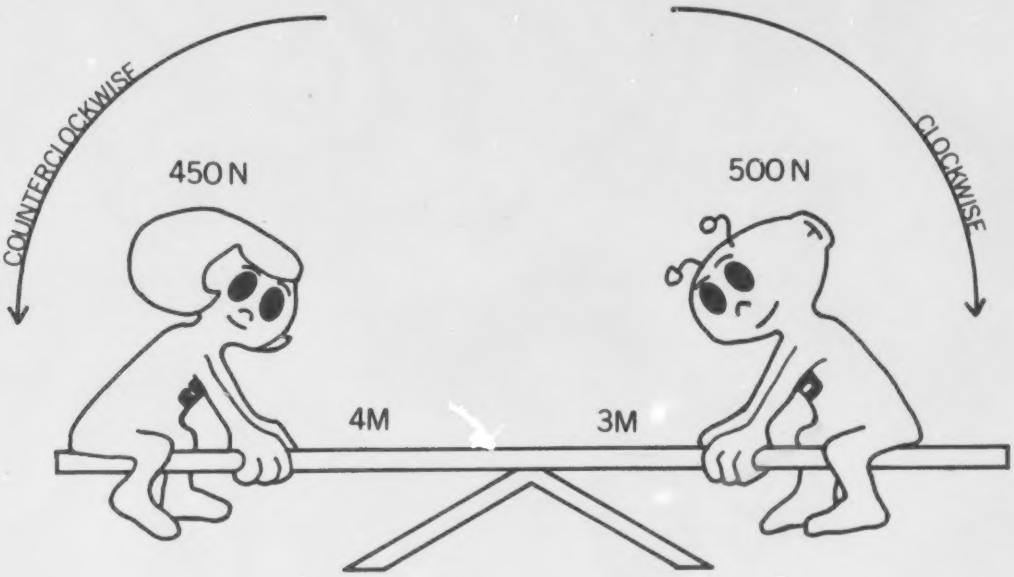
Student Action: Responding with the direction of imbalance and the amount of moment difference.

A: 1. Counterclockwise, 2. 300 newton-meters
B: 1. Counterclockwise, 2. 200 newton-meters
C: 1. Clockwise, 2. 150 newton-meters

1

Performance Check A: Mrs. Jones holds a seesaw while Johnny, who weighs 500 N, climbs on the right end 3 meters from the pivot. After his sister Alice, who weighs 450 N, gets on the other end at 4 meters, Mrs. Jones lets go.

1. Will the greater moment then cause the seesaw to turn clockwise or counterclockwise?
2. What is the amount of difference between the moments?



Remediation: (1) Using the data in the item, have the student calculate the moment on the right end. (2) If he doesn't know what is meant by *moment*, refer him to Excursion 12, page 352. (3) Have him calculate the moment on the left end. (4) See if he can complete the check. (5) If not, reassign the complete excursion.

O3
Exc
13
1

Computes the average of mixed numbers.

The student applies the procedure for finding an average of mixed numbers in which he adds the numbers and divides the total by the number of items in the set.

Student Action: Reporting the average for two sets of numbers and showing his work correct to within the indicated range.

A: 1. 2.4 to 2.6, 2. 2.7 to 2.9
B: 1. 7.7 to 7.9, 2. 4.4 to 4.6
C: 1. 5.4 to 5.6, 2. 7.1 to 7.3

Performance Check A: Find the average to one decimal place for each set of numbers. Show your work.

1. 1¼, 3½, 2¾
2. 2½, 3¼, 2¾

Remediation: (1) Can the student convert a mixed number to a decimal number? Ask him to change 3¼ to a decimal number. If he fails, refer him to Excursion 2, question 2-8 and following. (2) If he cannot find the average of several numbers, repeat Excursion 13. See 03-Core-19.

Recognizes the constancy of weight friction on a rectangular object.

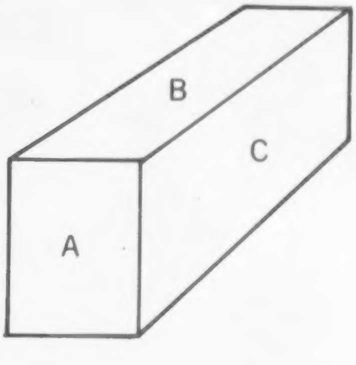
The student applies the concept that when acting on a rectangular object, the force of friction due to weight, is constant regardless of the surface area on which the weight rests.

Student Action: Selecting the one statement which indicates that the friction force is independent of surface area.

A: d
B: c
C: b

Performance Check A: The wood block shown below is dragged three times over a table. Each time a different surface, A, B, or C, is on the table. Which statement below best describes the result? The force of friction

a. will be greatest on surface C because it has the largest area.
b. will be greatest on surface A because there is more weight on it.
c. will be the smallest on surface C because there is less weight per square inch on it.
d. will be the same on all surfaces because the total weight acting on the surface is the same for A, B, and C.



Remediation: (1) Refer the student to Excursion 14. Either the student has forgotten the results of his experiment, or the data which he collected during the experiment led him to a wrong conclusion. (2) Check his response to question 14-8. Discuss this response with the student. If he found a direct relationship between surface area and friction, check his data and suggest that he redo an appropriate part of the experiment.

04

Chapters 8 and 9
Excursions 15 thru 19

Performance Check
Summary Table

Objective Number	Objective Description
04-Core-1	Names the kind of energy given to an elastic object by stretching or compressing
04-Core-2	Defines *potential energy*
04-Core-3	Selects quantities for calculating change in potential energy
04-Core-4	Calculates potential energy change due to height
04-Core-5	Recognizes potential energy changes
04-Core-6	Names the metric unit used in ISCS for measuring gravitational potential energy
04-Core-7	Measures the potential energy of an object at rest
04-Core-8	Names the input and output components of a system
04-Core-9	Defines *input work*
04-Core-10	Matches the term *energy supplier* to its definition
04-Core-11	Matches the term *energy receiver* to its definition
04-Core-12	Describes a method for detecting the motion energy in an object
04-Core-13	Predicts the effect of increasing the input work on a spinigig
04-Core-14	Calculates rotational speed
04-Core-15	Interprets a graph of a curve with a positive increasing slope
04-Core-16	Names the unit for reporting the speed of a rotating object
04-Core-17	Graphs data by drawing a best-fit line
04-Core-18	Interprets a negatively sloped curved line of graphed variables

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
				Q						classifies	
						√				recalls	
				Q					√	classifies	
				Q	T	√				applies	
						√				applies	
				Q		√				recalls	
	M		P	Q	T	√				applies	
				Q		√				classifies	
						√				recalls	
				Q		√				classifies	
				Q		√				classifies	
										applies	
						√				applies	
				Q			√			applies	
									√	applies	
				Q		√				recalls	
	M		P	Q	T	√				applies	
									√	applies	

04

Objective Number	Objective Description
04-Core-19	Describes the effect of increasing the mass of a rotating object when the input energy re-
	mains constant
04-Core-20	Defines *mass*
04-Core-21	Names the kind of energy required to increase the gravitational potential energy of ar
	object
04-Core-22	Names the forms of energy involved as an object changes position
04-Core-23	Names the input energy supplier and the output energy receiver
04-Core-24	Describes a method for measuring the motion energy of an object
04-Core-25	Calculates the motion energy of an object from the work it can do
04-Core-26	Recognizes labeling errors for energy suppliers and receivers
04-Exc 15-1	Describes the effect on mass and weight of changing an object's location
04-Exc 15-2	Describes how the mass of an object is related to its location
04-Exc 16-1	Selects the main contributions of early scientists to science today
04-Exc 17-1	Matches statements of kinds of relationships between variables with linear and curved-
	line graphs
04-Exc 18-1	Matches statements of the relationship between variables with the graphs they illustrate
04-Exc 19-1	Calculates kinetic energy from data
01-Core-7R	Matches terms *system*, *subsystem*, and *component* to definitions

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes .
						√				applies	
									√	recalls	
				Q					√	recalls	
				Q		√				classifies	
				Q		√				classifies	
									√	applies	
				Q					√	applies	
				Q		√				classifies	
									√	applies	
						√				applies	
				Q						classifies	
				Q						classifies	
				Q		√				classifies	
				Q	T		√		√	applies	
				Q		√				classifies	

04

Objective Number	**Objective Description**
01-Core-14 thru 17R	(Arithmetic skills)
01-Core-18 thru 22R	(Student's responsibilities)
02-Core-7R	Plots coordinates and draws a line on a grid
03-Core-6R	Defines *work* operationally
03-Core-9R	Matches the terms *system, subsystem*, and *component* to their definitions
03-Core-12R	Selects subsystems of a system
03-Core-13R	Recognizes the relationship between work and systems
03-Core-16R	Selects quantities and calculates input and output work
03-Core-21R	Predicts data from a graph

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
				Q		✓				applies	
	M	O		Q		✓				chooses	
			P		T	✓				applies	
						✓				recalls	
				Q		✓				classifies	
									✓	applies	
				Q		✓				classifies	
				Q	T				✓	applies	
	M		P	Q	T	✓				applies	

O4 Core 1

Names the kind of energy given to an elastic object by stretching or compressing.

The student classifies potential energy as the kind of energy given to an elastic object by compressing or stretching it.

Student Action: Selecting the term *potential energy*.

A: b
B: a
C: d

Performance Check A: Imagine that a spring is squeezed or a rubber band is stretched. What kind of energy is given to the spring or to the rubber band? Select the best answer below.

a. motion energy
b. potential energy
c. gravitational energy
d. frictional energy

Remediation: (1) Does the student know what potential energy is? If not, suggest a review of page 86, where potential energy is introduced. Check the student's responses to questions 8-16 through 8-19. (2) Ask the student what a spring that is squeezed or clockspring that is wound will do when it is released. (3) Reassess, using an alternate performance check.

O4 Core 2

Defines *potential energy*.

The student recalls either the definition that potential energy is stored energy or the definition that it is the ability to do work.

Student Action: Responding either that *potential energy* is stored energy or that it is the ability to do work.

Performance Check A: Charged batteries, gasoline, and sinkers hanging on a string have potential energy. What is meant by *potential energy* as used in that sentence?

Remediation: (1) Refer the student to page 86 where *potential energy* is defined. Check his responses to questions 8-16 through 8-19. (2) Ask the student whether charged batteries or loaded guns have the ability to do work.

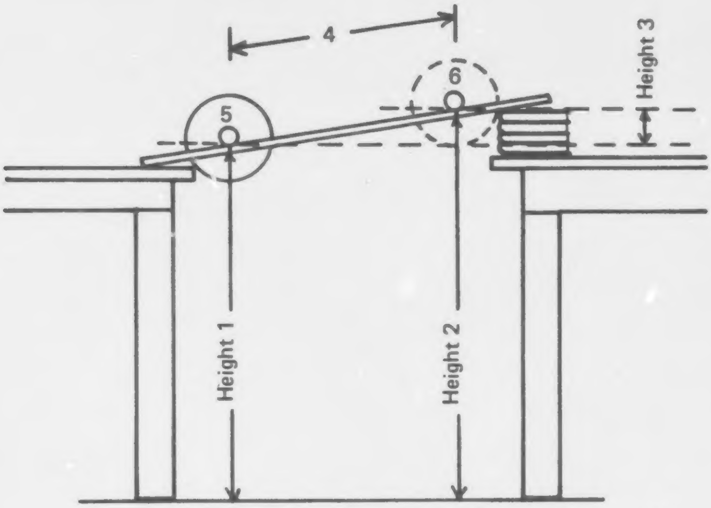
O4 Core

Selects quantities for calculating change in potential energy.

The student classifies the weight-force of the spinigig and the difference in the heights at the lower and higher positions as the force-distance pair of measurements to use in calculating the change in the potential energy of the spinigig.

3

Student Action: Selecting the weight and the change in height of the spinigig.
- **A:** a and c
- **B:** b and c
- **C:** b and e



Performance Check A: The spinigig is lifted off the track at 5 and set back onto the track at 6. Record the letters of any measurements you would use to calculate the change in the potential energy of the spinigig.
- a. Weight of the spinigig in newtons
- b. Weight of the spinigig track in newtons
- c. Height 3 in meters
- d. Height 2 above floor
- e. Distance 4 up the track

Remediation: (1) Ask the student to operationally define *potential energy*. If he can't do this, refer him to page 86. (2) Suggest that the student review Activity 8-7, page 85, in which he calculated the work he did in lifting the spinigig. (3) Check his response to questions 8-11, 8-12, 8-13, and Self-Evaluation Check 8-10.

04
Core

Calculates potential energy change due to height.

The student applies the rules for calculating the potential energy of a lifted object.

Student Action: Reporting the product, to the nearest newton-meter, of the weight and the change in height and showing his calculations.
- **A:** 1. 22.8 N·m, 2. 75 N·m, 3. 150 N·m
- **B:** 1. 2.7 N·m, 2. 10.8 N·m, 3. 26 N·m
- **C:** 1. 54 N·m, 2. 150.1 N·m, 3. 282.2 N·m

4

Performance Check A: A trip-hammer is used to drive steel fence posts into the ground. Three different size hammers are raised to different heights above the tops of three posts. Calculate the potential energy of each hammer before it is dropped. Show your calculations and answers on your paper.

Post Size	Weight of Hammer (in newtons)	Height above Post (in meters)
1. Small	28.5	0.8
2. Medium	53.6	1.4
3. Large	75.0	2.0

Remediation: (1) Ask the student how he would measure potential energy by referring him to the activities on page 89 where he measured the potential energy which the cup of nails gave to the mass. (2) Suggest that he reread the last paragraph on page 89, where he was told how to measure potential energy. (3) Check his answer to question 8-24, discuss what variables determined this answer, and ask how he combined these variables. (4) Ask the student to reevaluate his response to Self-Evaluation Checks 8-1 and 8-9. (5) Reassess the objective with an alternate performance check.

O4 Core 5

Recognizes potential energy changes.

The student applies the concept that there is a change in the energy of an object when it is lifted and that the kind of energy it is given is gravitational potential energy.

Student Action: Responding that the object does undergo an energy change and stating either the term *potential energy* or the term *gravitational potential energy* as the kind of energy involved.

Performance Check A:

1. If you lift a concrete block off the ground to the top of a wall, do you give it energy?
2. If so, what kind of energy do you give it? If not, why don't you give it energy?

Remediation: (1) Refer the student to page 83, and ask him what he had to do to the spinigig in order for it to influence the sinker. What was the spinigig in a position to do when it was at the top of the track? Did he give the spinigig energy? (2) If the student can answer (1), but is uncertain what kind of energy is given to an object in lifting it, refer him to the discussion of potential energy on page 86. (3) Reassess, using an alternate performance check.

O4

Names the metric unit used in ISCS for measuring gravitational potential energy.

The student recalls that the metric unit *newton·meter* is the unit used in ISCS for measuring gravitational potential energy.

Core 6

Student Action: Naming the term *newton-meter.*

Performance Check A: What is a metric unit used in ISCS for measuring potential energy due to gravity?

Remediation: (1) Ask the student to operationally define the *potential energy* of a battery or a spinigig. If he is unable to do this, refer him to the last paragraph on page 86. (2) After he has operationally defined *potential energy*, suggest that he review page 51 where the units for work are introduced. (3) Reassess the student's knowledge of this definition by checking the units in his answer to a performance check in 04-Core-7.

---

04 Core 7

Measures the potential energy of an object at rest.

The student applies the procedure for measuring the potential energy of an object at rest which includes measuring the distance of the object from the floor, measuring the weight force of the object, and multiplying the measurements together.

Regular Supplies:
1 meterstick
1 force measurer

Special Preparations: For each alternate-form performance check, hang an object weighing between 1 and 10 newtons between 70 and 100 cm above the floor. Change the object or the height for alternate performance checks, and label the object 04-Core-7A, 04-Core-7B, or 04-Core-7C, as appropriate. Calculate the potential energy of the object, and record your results for your reference under "Student Action" below.

Student Action: Reporting the calculated potential energy for an object in newton-meters within ±5% of the value determined by the teacher.

A: ______ N·m (object name ______________, object height ______)
B: ______ N·m (object name ______________, object height ______)
C: ______ N·m (object name ______________, object height ______)

Performance Check A: Your instructor has suspended an object, labeled 04-Core-7A, above the floor. Use your force measurer and a meterstick to find its potential energy. Show your measurements and calculations.

Remediation: (1) Suggest that the student review the activities he did on pages 88 through 90, where he measured the potential energy of the cup of nails and the work done in lifting the mass. Check Table 8-1 and his answers to questions 8-21 and 8-24. (2) Ask the student to reevaluate his response to Self-Evaluation Check 8-4. (3) Reassess, using an alternate check.

04

Names the input and output components of a system.

The student classifies the input component as the object which puts work (energy) into the system and the output component as the object on which the system does work.

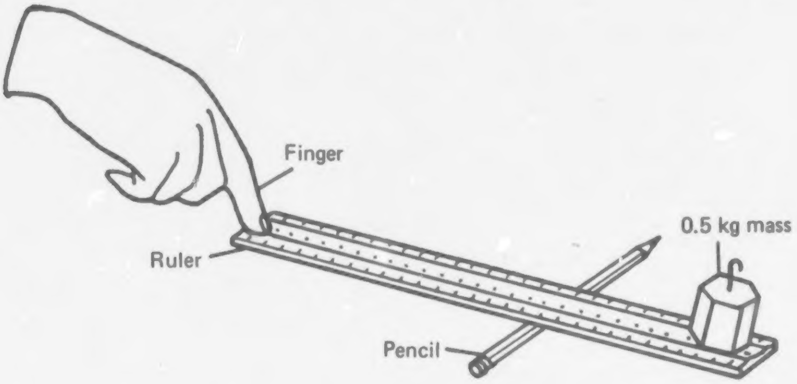
Core 8

Student Action: Selecting the appropriate input and output components.

- **A:** 1. Finger, 2. the 0.5 kg mass
- **B:** 1. ISCS battery, 2. Weight
- **C:** 1. Boy, 2. Football

Performance Check A: Look at the diagram below. The finger pushing down on the ruler lifts the 0.5 kg mass.

1. Name the component doing the input work.
2. Name the component receiving the output work.



Remediation: (1) Refer the student to page 59, Chapter 6, where *input* and *output* are introduced. Suggest that he review the activities with the balance rod on pages 59 and 60, where he had to determine input and output components. (2) Check his answers to questions 6-8, 6-9, 6-12, and 6-17. (3) Reassess, using an alternate check.

---

04 Core 9

Defines *input work.*

The student recalls the definition that input work is the work done on a system.

Student Action: Responding to the effect that input work is the work done on a system.

Performance Check A: Write in your own words what *input work* is.

Remediation: (1) *Input work* is defined on page 59. However, rather than have the student turn to that page and memorize the definition, give him examples of different systems and ask him to identify the input work in each system. (2) After such a discussion of examples of input work, the student should be able to define *input work* in his own words.

04

Matches the term *energy supplier* to its definition.

The student classifies the energy supplier in a system as the object that does work on something else.

Core
10

Student Action: Selecting the term *energy supplier.*

A: a
B: d
C: b

Performance Check A: Select the phrase that completes the following sentence. In a system, the object that does work on something else is called the

a. energy supplier.
b. input work.
c. output work.
d. energy receiver.

Remediation: (1) Suggest that the student review page 90, where *energy supplier* and *energy receiver* are introduced. (2) Check his answers to questions 8-31 through 8-34 and also his understanding of Figure 8-3, page 93. (3) It may be essential to discuss how input work and an energy supplier differ. (4) Ask the student to check his response to Self-Evaluation Check 8-2 b.

04
Core
11

Matches the term *energy receiver* to its definition.

The student classifies the energy receiver in a system as the object that has work done on it.

Student Action: Selecting the term *energy receiver.*

A: c
B: d
C: b

Performance Check A: Select the phrase that completes the following sentence. In a system, the object that has work done on it by something else is called the

a. input work.
b. output work.
c. energy receiver.
d. energy supplier.

Remediation: (1) See the Remediation for 04-Core-10. (2) It may be essential to discuss how energy receivers and output work differ. (3) Ask the student to check his response to Self-Evaluation Check 8-2 a.

04
Core

Describes a method for detecting the motion energy of an object.

The student applies the principle that an object has motion energy if it can be observed changing position with time, if a point on its surface appears to be moving, or if it does work on something.

Student Action: Stating the effect of one of the following: An object has motion energy if (1) it can be observed changing position as time passes, (2) a point on its surface appears to be moving, or (3) it does work on something.

12

Performance Check A: State a way in which you can tell if an object has motion energy. You may use an example if you wish.

Remediation: (1) Use the example of the turning spinigig, page 96. What did this spinigig in motion do to the hanging sinkers? Ask the student to recall the definition for *energy*. Did the turning spinigig have motion energy? What is the spinigig, which has motion energy while turning, capable of doing to the sinkers? (2) Refer the student to Activity 9-4 on page 100 and have him explain how he determines a turn of the spinigig. (3) Ask the student to check his response to Self-Evaluation Check 9-7. (4) Reassess the objective by asking the student for another example of an object having motion energy.

O4 Core 13

Predicts the effect of increasing the input work on a spinigig.

The student applies the concept that increasing the input work on a spinigig will increase the speed of its rotation if the number of disks remains the same.

Student Action: Responding to the effect that increasing the input work on a spinigig will increase the speed of its rotation.

Performance Check A: Set in the roller bearing blocks, you have a 4-disk spinigig with a string wrapped around its axle. Attached to the string is one sinker that can fall 1 meter and cause the spinigig to spin. What effect would adding more sinkers have on the spinigig's speed of rotation?

Remediation: (1) Suggest that the student review Activities 9-4 and 9-5. Refer him to Table 9-2 and Figure 9-2 in which input work and speed are compared. (2) Check his responses to questions 9-9, 9-10, and 9-12.

O4 Core 14

Calculates rotational speed.

The student applies the rule that the speed of a rotating object may be calculated by dividing the number of revolutions by the time taken in making them.

Student Action: Reporting his calculation of the turns per second from the given data, within the range of a 10% error.

A: 0.5 turns per second
B: 0.5 turns per second
C: 0.2 turns per second

Performance Check A: Suppose your spinigig turns 5 times in 10 seconds. What is its speed in turns per second? Show your calculations on your paper.

Remediation: (1) Suggest that the student study page 101 where he is shown how to calculate the speed of the spinigig. (2) Check the calculations for speed in Tables 9-2 and 9-3. (3) Reassess, using an alternate check.

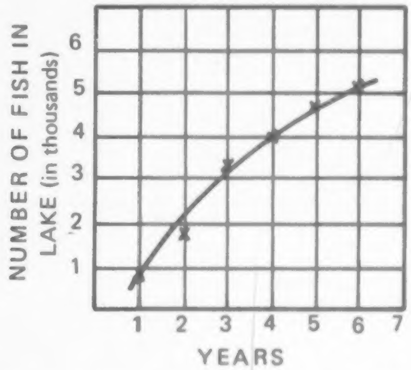
04 Core 15

Interprets a graph of a curve with a positive increasing slope.

The student applies the concept that a graph of a curved best-fit line that slopes upward to the right shows that an increase in one variable is related to an increase in the other variable but not at the same rate of change.

Student Action: Responding to the effect that the number of specimens increases but at a reduced rate as the number of years increases.

Performance Check A: What does the curved line on the grid tell you about the fish population in the lake? (Hint: How does the change in the fish population between the 5th and 6th years compare with the change between the 1st and 2nd years?)



Remediation: (1) A similar slope occurs in the graph of the relationship between input work and speed in Figure 9-2, page 102. Check the student's responses to questions 9-9, 9-10, and 9-12. (2) Have the student examine several points on the graph in Figure 9-2 of his *Student Record Book*. (3) Excursion 18 gives a brief but helpful summary of the kinds of relationships shown by different graphs.

04 Core 16

Names the unit for reporting the speed of a rotating object.

The student recalls that units for reporting the speed of a rotating object are expressed as turns – or rotations or revolutions – per time unit.

Student Action: Responding with the unit for reporting the speed in one of these three forms: turns per time unit, rotations per time unit, or revolutions per time unit.

Performance Check A: Name the unit used to report the speed of a spinning object such as a spinigig.

Remediation: (1) Refer the student to Tables 9-2 and 9-3, where he calculated the speed of the spinigig. Ask him which variables determine speed and what the units for these variables are. (2) How do you combine these variables (units) to determine speed? The first paragraph on page 101 shows how the variables and units are combined through division to calculate speed.

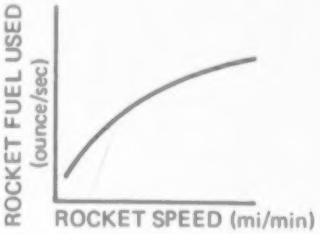
04 Core 17

Graphs data by drawing a best-fit line.

The student applies the procedure for plotting coordinates on a grid and drawing a best-fit curved line.

Student Action: Plotting the coordinates and drawing a best-fit line that passes through or near the points.

A, B, and C: The student's graph should have the general shape shown below.



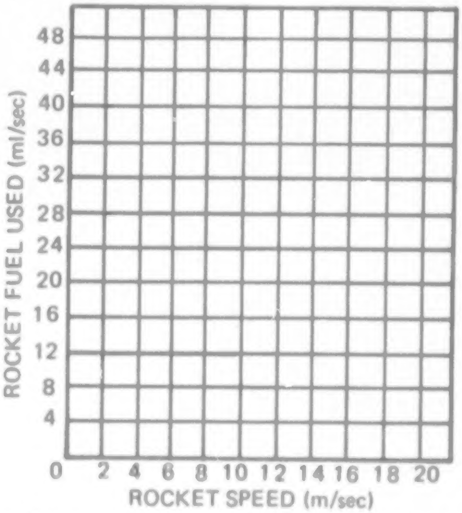
Special Preparation: You will need to have available either appropriate grid paper or duplicated grids, labeled like the one below.

Teacher's Note: Note that simpler, but similar, performance is required in Performance Check 02-Core-7.

Performance Check A: Get some graph paper, draw a pair of axes, and label them as shown below. Use your grid and the table below to plot rocket speed against fuel used. Draw a best-fit line for the plotted points.

Rocket Speed Per Ml of Fuel

Speed (m/sec)	Fuel (ml/sec)
2	13
4	18
6	22
8	25
10	26
12	28
14	29
16	30
18	30



Remediation: (1) If the student has trouble making a graph, refer him to Excursions 4 and 5. If his problem is making a best-fit line, suggest he do Excursion 5. (2) The student should have plotted a best-fit curved line from a table in Figures 9-2 and 9-3 on pages 102 and 104. Check these graphs, and discuss the way they are constructed.

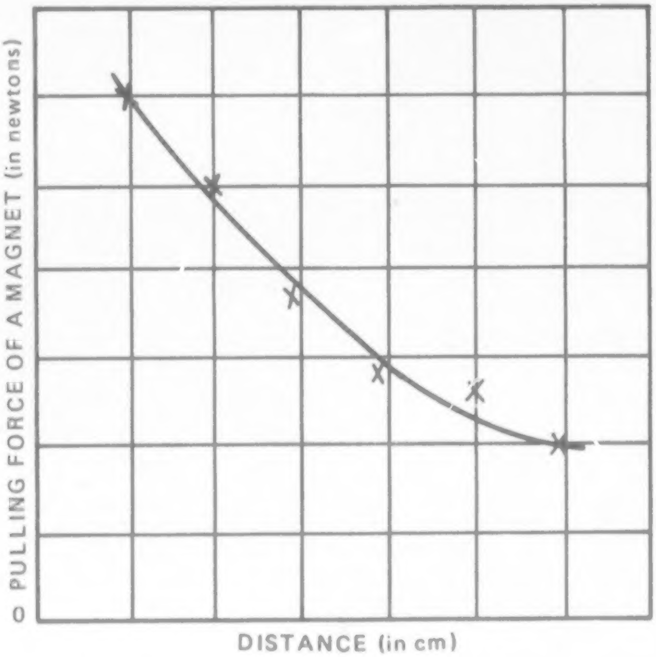
Interprets a negatively sloped curved line of graphed variables.

04
Core
18

The student applies the concept that a curved, best-fit line that slopes downward to the right shows that an increase in one variable is related to a decrease in the other variable, but not at a constant rate.

Student Action: Responding to the effect that a curved line that slopes downward to the right shows that an increase in one variable is related to a decrease in the other variable, but not at a constant rate.

Performance Check A: What two things does the best-fit curved line on the grid below tell you about the magnet?



Remediation: (1) Check Figure 9-3 in the *Student Record Book*. That graph shows the same relationship between mass and speed as does the relationship between the variables above. Discuss the graph in Figure 9-3 with the student. (2) This relationship is also graphed in Excursion 8. If the student has done that Excursion, the graph on page 322 can also be used for discussion.

Describes the effect of increasing the mass of a rotating object when the input energy remains constant.

04
Core

The student applies the concept that the speed of a rotating body decreases if its mass is increased and its input energy is held constant.

Student Action: Responding to the effect that the speed would decrease if the mass were increased and the input energy were held constant.

19

Performance Check A: A spinigig with 2 disks and a string wrapped around its axle is set into the roller skate wheels and placed on the track. Attached to the string is one sinker that can fall one meter and cause the spinigig to spin. What effect would increasing the number of disks on the spinigig have on its speed of rotation?

Remediation: (1) Suggest that the student review Activity 9-6, page 103, in which he changed the mass of the spinigig and held the input energy constant. Table 9-3 and the graph in Figure 9-3 also show this relationship. (2) Check Figure 9-3 in the *Student Record Book* and discuss this graphic representation with him if necessary.

04
Core
20

Defines *mass.*

The student recalls the definition that mass is the quantity of matter in an object.

Student Action: Responding that mass is the quantity of matter in an object.

Teacher's Note: (1) *Mass* should not be defined as a type of force. (2) If the student responds that mass is what causes an object to take up space and have weight, he is not wrong. The ISCS definition, however, focuses on the matter which causes the object to exhibit those properties.

Performance Check A: Define *mass.* (Hint: Consider how it is used in the following sentence.) Debbie compared the mass of the sinkers with the mass of the golf ball and found they were equal.

Remediation: (1) Refer the student to the introduction to *mass* on page 98. (2) Excursion 15, which shows a distinction between mass and weight, may be beneficial for the curious student, if time permits. (3) Ask the student to check his response to Self-Evaluation Check 9-12. (4) Reassessment will be made at a later date.

04
Core
21

Names the kind of energy required to increase the gravitational potential energy of an object.

The student recalls that in certain situations kinetic, or motion energy, must be applied to an object to increase its potential energy.

Student Action: Responding to the effect that motion energy was applied to increase the object's gravitational potential energy.

Performance Check A: A tow truck's winch lifted a car from the road. The car gained potential energy. What kind of energy did the winch apply to the car?

Remediation: Discuss Activity 9-3, page 96, with the student. As he turned the spinigig and lifted the sinker, what kind of energy did the sinker gain? What did he have to do to the spinigig in order for the sinker to gain potential energy? What kind of energy did he apply to the spinigig and in turn to the sinker?

Names the forms of energy involved as an object changes position.

04 Core 22

The student classifies an object's energy as potential energy when the object is suspended, as motion (or kinetic) energy when the object is falling, and the force acting on the object as gravity, or weight.

Student Action: Responding "potential energy" for the suspended object, "kinetic energy" or "motion energy" for the falling object, and "gravity" or "weight" for the force acting to change the energy.

Performance Check A:

1. What kind of energy does a large rock have when it is held twenty feet above the ground by a rope?
2. If the rope is cut and the rock falls, its energy changes. What kind of energy is it changed to?
3. What force acts upon the rock to change the energy after the rope is cut?

Remediation: (1) Does the student know what potential energy is? Have him review page 86, where it is introduced. Also check his response to question 9-21. (2) If the student has difficulty understanding motion energy, discuss with him Activity 9-3 on page 96. Check his answer to question 9-19. Discuss Activity 9-7 on page 106 if his difficulty lies with (1) and (2). (3) Ask the student what happened to the object in his performance check (a rock, an elevator, or a bale of cotton) when the support was cut. What force causes objects to fall? What force was it, then, which acted upon the object under consideration to change its energy?

Names the input energy supplier and the output energy receiver.

04 Core 23

The student classifies the supplier of the input energy to a system and the receiver of the output energy from that system.

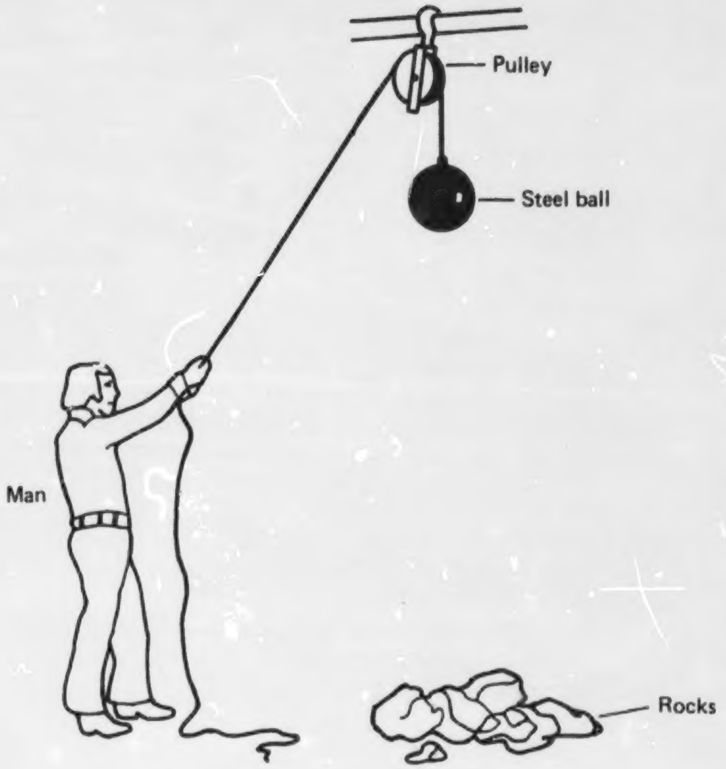
Student Action: Responding by correctly naming both the supplier of input energy and the receiver of output energy.

A: 1. the man, 2. the rocks
B: 1. the man, 2. the post
C: 1. the boy, 2. the shell

Performance Check A: Look at the diagram below. A steel ball is dropped on rocks to crush them. The ball is lifted to a height of ten feet above the rocks by a man using a pulley.

1. Name the supplier of input energy to the system.
2. Name the receiver of output energy from the system.

(Continued)



Remediation: (1) Suggest that the student review Figures 9-4 and 9-5 on pages 104 and 105, and the related paragraphs. They provide a good review of energy suppliers and receivers as related to the activities in Chapter 9. (2) Figure 8-2 on page 90 can also be discussed. (3) Reassess, using an alternate check.

---

04 Core 24

Describes a method for measuring the motion energy of an object.

The student applies the concept that the energy of a moving object can be quantified by measuring the work that it does on another object.

Student Action: Responding to the effect that the measurement of the energy of a moving object is the measurement of how much work the object can do.

Performance Check A: When your hand moves, it has energy. It can beat on a bongo drum. How could you measure the energy of a moving hand as it strikes the drum?

Remediation: (1) Suggest that the student review pages 105 and 106 on "Measuring Motion Energy." Discuss this with him. Check his responses to questions 9-16 and 9-17. (2) Activity 9-7 can also be discussed. (How was the energy of the moving object measured here?)

04 Core 25

Calculates the motion energy of an object from the work it can do.

The student applies the concept that the measure of the motion energy of a moving object is determined by measuring the work that the moving object does on some other object.

Student Action: Reporting to the nearest newton·meter the work that the moving object does on another object.

- **A:** 7 N·m
- **B:** 50.4 N·m
- **C:** 67.2 N·m

Performance Check A: The force required to slide a brick on the sidewalk is 3.5 newtons. Bob threw a baseball at the brick and caused the brick to slide 2.0 meters. If all the motion energy of the baseball was given to the brick, how much motion energy did the baseball have?

Remediation: (1) See the Remediation for 01-Core-24. (2) Check the student's response to question 9-20 on page 107. Ask the student how he calculated his answer.

04 Core 26

Recognizes labeling errors for energy suppliers and receivers.

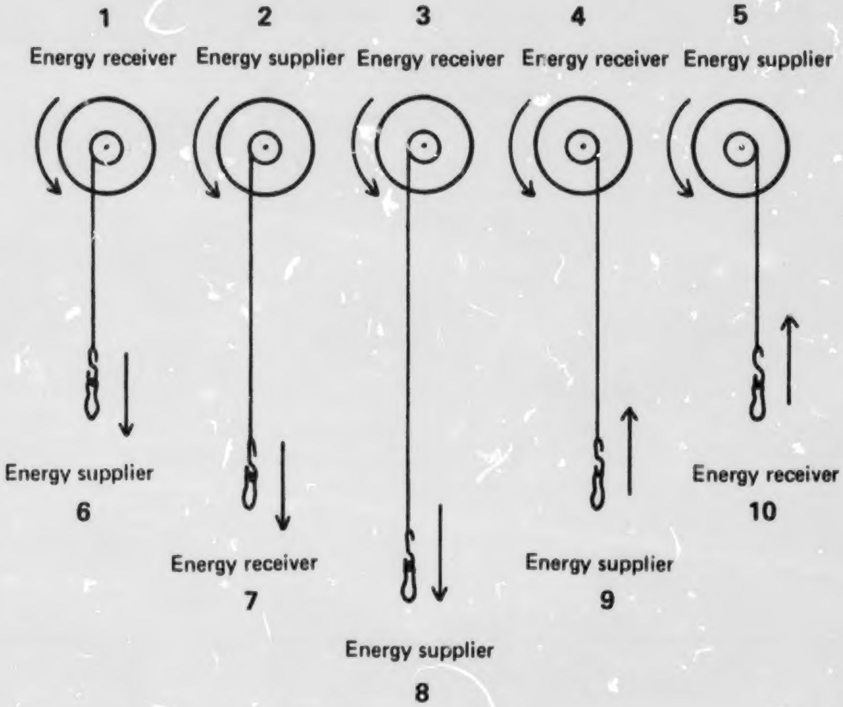
The student classifies on a diagram of a system the energy receiver as the object upon which work is being done or whose motion is being altered by another object and an energy supplier as the object which is doing work on another object or altering its motion.

Student Action: Selecting the incorrectly labeled energy suppliers and energy receivers.

- **A:** 2, 7, 4, 9, and no others
- **B:** 1, 6, 3, 8, and no others
- **C:** 3, 4, 9, 10, and no others

Performance Check A: In the drawings below, arrows correctly show the direction in which five spinigigs are moving. However, some of the labels are incorrect. List the number of each of the incorrect labels.

(Continued)



Remediation: (1) A discussion of Activity 9-3, page 90, in terms of energy suppliers and receivers would be beneficial. (2) Figure 9-1 should then be referred to. (3) An alternate check can be used for reassessment, if necessary.

O4
Exc
15
1

Describes the effect on mass and weight of changing an object's location.

The student applies the concepts that while the weight of an object is dependent upon its location, its mass is not.

Student Action: Stating that in changing its position, the mass of the ball would not change, that its weight would decrease, and that an object's mass is simply the amount of matter in it, whereas its weight depends on its mass and the local force of gravity.

Performance Check A: Io is the moon of the planet Jupiter. It is larger than earth's moon. The force of gravity on a 1 kg mass on Io is about 1.78 newtons. On earth, it is about 9.8 newtons.

1. If a golf ball were taken from the earth to Io, would its mass change?
2. What would happen to its weight?
3. How did you know the answers to give?

Remediation: (1) Suggest that the student review Excursion 15, especially page 372. (2) Check his responses to questions 15-12 through 15-15. (3) Discuss with him how mass and weight differ.

04
Exc
15
2

Describes how the mass of an object is related to its location.

The student applies the concepts that an object's mass is a measure of the amount of matter it contains and is independent of its location.

Student Action: Responding that the mass did not change and that since mass is the amount of matter in an object, it would not change when the object is moved.

Performance Check A: One of the astronauts took a golf ball to the moon.

1. Did the mass of the golf ball change during the trip?
2. What have you learned about *mass* that supports your answer?

Remediation: (1) Have the student review Excursion 15. (2) A brief discussion of what the student learned about mass may be necessary. (3) Check his responses to questions 15-14 and 15-15 on page 372.

04
Exc
16
1

Selects the main contributions of early scientists to science today.

The student classifies science as a creative activity productive of ideas and scientists as builders on the ideas of their predecessors.

Student Action: Selecting the responses indicating that the scientists studied contributed new ideas and that scientists build upon the ideas of their predecessors.

A: 1. b, 2. c
B: 1. a, 2. b
C: 1. c, 2. d

Performance Check A: Answer both 1 and 2 below by selecting the letter that best completes the sentence in each case.

1. Excursion 16, "Forerunners of Space Travel," tells how eleven men who lived from 400 B.C. to 1725 A.D. developed ideas about astronomy. One thing that all of these men did was
    a. invent instruments to measure or observe with.
    b. contribute new ideas.
    c. make maps of the earth or planets.
    d. build rockets or spaceships.
2. Newton said, "If I have seen further than other men, it is because I have stood on the shoulders of giants." He meant that
    a. he was a very modest man and didn't want praise.
    b. he was short himself but could see farther when someone held him up.
    c. he had the advantage of others' ideas and could improve and advance them.
    d. he could explain the gravity that holds stars in galaxies because the others couldn't see outside the solar system.

Remediation: (1) A brief discussion of Excursion 16 would be beneficial. What do these eleven great men have in common? Is there evidence that their work was built on the work of others? (2) If necessary, Newton's quote on page 377 can be specifically examined in this discussion to help the student decide what Newton meant.

04
Exc
17
1

Matches statements of kinds of relationships between variables with linear and curved-line graphs.

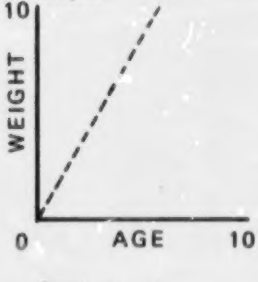
The student classifies the relationship between the variables in linear and simple curve graphs.

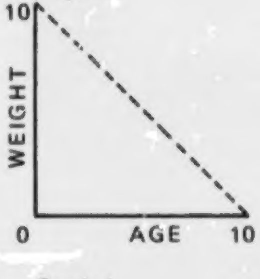
Student Action: Matching each graph to the statement which describes best the relationship it depicts.

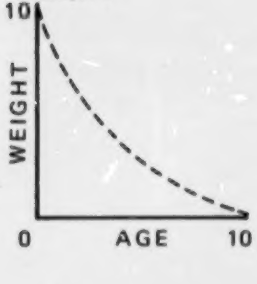
A: 1. a, 2. c, 3. b, 4. d
B: 1. c, 2. b, 3. d, 4. a
C: 1. c, 2. b, 3. a, 4. d

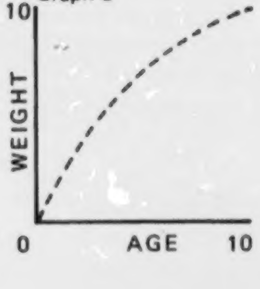
Performance Check A: Each of the following four statements describes a relationship between the variables age and weight. Beside the number of each statement, record the letter of the graph below which shows the same relationship.

1. As age increases, weight increases at a constant rate.
2. As age increases, weight decreases at a changing rate.
3. As age increases, weight decreases at a constant rate.
4. As age increases, weight increases at a changing rate.


Graph a


Graph b


Graph c


Graph d

Remediation: (1) Have the student review Excursion 17. (2) It would be helpful to discuss each graph with the student. Slightly different values can be assigned to specific points on the graphs. By comparing the relative coordinates of these different points, the student can classify the relationship. (3) Urge the student to do Excursion 18, which provides a summary of the different relationships. Excursion 18 also refers to specific graphs in the text which depict each relationship.

04
Exc
18
1

Matches statements of the relationship between variables with the graphs they illustrate.

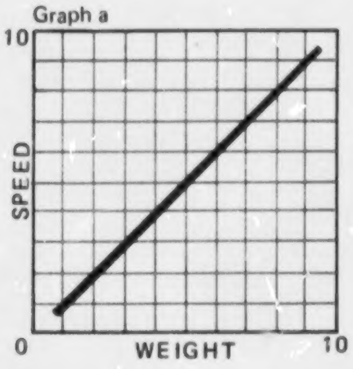
The student classifies linear graphs by matching them with statements of the relationship of the two variables plotted.

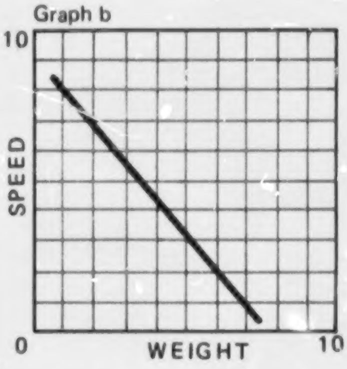
Student Action: Matching the appropriate graph with each of the four statements.

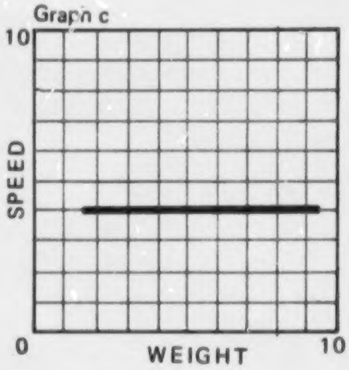
A: 1. b, 2. c, 3. b, 4. a
B: 1. b, 2. c, 3. a, 4. b
C: 1. c, 2. b, 3. a, 4. a

Performance Check A: After the number of each of the following four statements, write the letter of the graph that illustrates the relationship described in the statement. You may use the letter of a graph more than once.

1. When weight increases at a constant rate, speed decreases at a constant rate.
2. When weight increases at a constant rate, speed is not changed.
3. When weight decreases at a constant rate, speed increases at a constant rate.
4. When weight increases at a constant rate, speed increases at a constant rate.







Remediation: (1) It would be helpful to have a discussion with the student in which you assign slightly different values to the points on the graph. By comparing the relative coordinates of these different points, the student can classify the relationship. (2) Both Excursion 17 and a review of Excursion 18 will be beneficial for the student.

04
Exc
19
1

Calculates kinetic energy from data.

The student applies the formula $KE = \frac{1}{2}ms^2$ to calculate the difference in energy between two moving objects.

Student Action: Showing his calculations of the specified kinetic energy of the two objects and reporting the difference between their KE, (10%), and selecting the object which has more energy.

A: 1. KE beach ball = $\frac{1}{2} \times 15 \times 3^2 = 67.5$ N·m, KE exercise ball = $\frac{1}{2} \times 2 \times 15^2 = 225$ N·m, KE difference = 225 N·m - 67.5 N·m = 157.5 N·m
2. The exercise ball

B: 1. KE object A = $\frac{1}{2} \times 3 \times 7^2 = 73.5$ N·m, KE object B = $\frac{1}{2} \times 15 \times 3^2 = 67.5$ N·m, KE difference = 73.5 N·m - 67.5 N·m = 6.0 N·m
2. Object A

C: 1. KE wagon one = $\frac{1}{2} \times 40 \times 10^2 = 2000$ N·m, KE wagon two = $\frac{1}{2} \times 10 \times 40^2 = 8000$ N·m, KE difference = 8000 N·m - 2000 N·m = 6000 N·m
2. wagon two

Performance Check A: A beach ball with water in it has a mass of 15 kg. It has been tossed at a speed of 3 meters per second and is traveling toward you. At the same time a 2 kg exercise ball is thrown toward you at 15 meters per second speed. Use the formula $KE = \frac{1}{2}ms^2$ to answer the following questions. Your answers will be in newton-meters.

1. What is the difference in the energy of the two moving objects? Show your calculations.
2. Which ball would be more difficult to stop?

Remediation: (1) If the student has forgotten how to use the formula for KE, have him review page 385 of Excursion 19. Check questions 19-1, 19-5, and 19-6 on pages 386 and 387. (2) If he understands Remediation (1) but has a problem determining the difference between the two K.E.'s, you may discuss this with him. (3) A discussion as to why one object might be more difficult to stop may be imperative if the student had difficulty with the response. (4) Reassess, using an alternate check.

05

Chapters 10 and 11

Excursions 20 thru 22

Performance Check

Summary Table

Objective Number	Objective Description
05-Core-1	Names the kind of energy acquired by a stretched elastic object
05-Core-2	Recognizes the relationship of the variables involved in work
05-Core-3	Calculates potential energy in newton-meters
05-Core-4	Defines *kinetic energy* operationally
05-Core-5	Describes a way to detect kinetic energy
05-Core-6	Describes a way to measure kinetic energy
05-Core-7	Selects the conditions of maximum kinetic and potential energies of an elastic object
05-Core-8	Selects the net amount of two forces acting on an object and its direction
05-Core-9	Recognizes changes in the speed of a water-clock cart from a water-drop record
05-Core-10	Names the force that causes objects to roll down inclines naturally
05-Core-11	Names the force which causes rolling objects to slow down
05-Core-12	Names the force which reduces useful output energy
05-Core-13	Compares amounts of input work with amounts of output work
05-Core-14	Relates friction to temperature change
05-Core-15	Lists several forms of energy
05-Core-16	Selects relative amounts of potential and kinetic energy
05-Core-17	Describes a procedure for detecting and measuring light energy
05-Core-18	Explains how light can be shown doing work

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
				Q		✓				classifies	
							✓		✓	applies	
				Q				✓		applies	
						✓				generates	
				Q		✓				applies	
				Q		✓				applies	
				Q						applies	
				Q						generates	
				Q		✓				classifies	
				Q		✓				classifies	
				Q		✓				classifies	
				Q		✓				classifies	
				Q		✓				applies	
				Q		✓				applies	
				Q		✓				recalls	
				Q				✓	✓	applies	
									✓	generates	
						✓				applies	

05

Objective Number	Objective Description
05-Core-19	Selects the form of energy which moves the liquid in a palm glass
05-Core-20	Gives examples of electrical energy's being changed into kinetic energy
05-Core-21	Labels the energy conversions of potential energy to kinetic energy and kinetic energy to potential energy
05-Core-22	Recognizes the characteristics of energy
05-Core-23	Names input and output forms of energy
05-Core-24	Gives examples of energy conversion
05-Exc 20-1	Calculates the speed of a water-clock cart
05-Exc 21-1	Uses circumference and time of motion to calculate speed
05-Exc 22-1	Selects the variables which determine momentum
01-Core-7R	Matches terms *system, subsystem,* and *component* to definitions
01-Core-14 thru 17R	(Arithmetic skills)
01-Core-18 thru 22R	(Student's responsibilities)
03-Core-6R	Defines *work* operationally
03-Core-13R	Recognizes the relationship between work and systems
03-Core-22R	Names the force resisting sliding objects
04-Core-2R	Defines *potential energy*
04-Core-3R	Selects quantities for calculating change in potential energy

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
	M			Q		✓				classifies	
						✓				applies	
				Q		✓				classifies	
				Q					✓	classifies	
						✓				classifies	
					T					classifies	
				Q	T		✓			applies	
	M			Q	T		✓			applies	
				Q					✓	classifies	
				Q		✓				classifies	
				Q		✓				applies	
	M	O		Q		✓				chooses	
						✓				recalls	
				Q		✓				classifies	
				Q		✓				classifies	
						✓				recalls	
				Q		✓				classifies	

05

Objective Number	Objective Description
04-Core-21R	Names the kind of energy required to increase the gravitational potential energy of an
	object
04-Core-24R	Describes a method for measuring the motion energy of an object
04-Core-25R	Calculates the motion energy of an object from the work it can do

	Materials	Observer	Special Preparations	Quick Score	3 + Minutes	Basal	Math	Reading	Concept	Action Verbs	Notes
				Q		✓				recalls	
						✓				applies	
				Q		✓				applies	

O5 Core 1

Names the kind of energy acquired by a stretched elastic object.

The student classifies the energy acquired by an elastic object when it has been stretched as potential energy.

Student Action: Responding "potential energy."

Performance Check A: When a rubber band has been stretched, what kind of energy does it have?

Remediation: (1) Does the student know what potential energy is? If not, refer him to page 86. (2) Does it take a force to stretch a rubber band, a spring, or a piece of elastic? Does this force act through a distance? Does this work give it energy? What kind of energy is it given?

O5 Core 2

Recognizes the relationship of the variables involved in work.

The student applies to two cases the concept that because work is the product of the force acting and the distance through which it acts, work done is dependent on the size of both variables, not just one of the two.

Student Action: Responding affirmatively and stating the effect of the concept.

Performance Check A:

	Trial 1	Trial 2
Average of force of blade	8.7 N	7.4 N
Distance blade tip moved	0.019 m	0.046 m
Work done on cart	0.141 N·m	0.321 N·m

Brent used his force measurer as the input work supplier to his water-clock cart. When he reviewed his data, he noticed that in Trial 1 he had used a larger force than in Trial 2. But he had done less work on the cart. Could this be true? Explain your answer.

Remediation: (1) Ask the student whether he would rather be hit by a Volkswagen or a Cadillac and why (mass). Then ask if it makes a difference to know a second variable – that the Cadillac is going 2 mph and the Volkswagen is going 60 mph. (2) Ask him what two variables affect work. Discuss these variables with him. What must you do with these variables to calculate work? (3) Use the table in the item to discuss relative amounts of force and distance and how they relate to work. If you increase the force but decrease the distance, will work always increase, decrease, or stay the same? Is work, then, dependent only on force, or on both force and distance?

05 Core 3

Calculates potential energy in newton-meters.

The student applies the rule that if a variable force acts through a distance, the potential energy may be calculated by multiplying the average of the initial and the final force amounts by the distance through which the force acts.

Student Action: Calculating the energy and reporting it within the range of a 10% error.

A: 0.24 newton-meters (±0.02 N·m)
B: 0.36 newton-meters (±0.04 N·m)
C: 0.21 newton-meters (±0.02 N·m)

Performance Check A: John brought a toy cannon to class. He found it took 1.5 newtons of force to start to compress the spring in the cannon, and the force had to be increased to 6.5 newtons to compress the spring completely. The distance the front of the spring moves when released is 0.06 m. What is the potential energy of the spring when fully compressed?

Remediation: (1) Does the student know how to measure potential energy? If not, refer him to the bottom of page 89 and to his response to Self-Evaluation Check 10-2, parts b and c. (2) If he doesn't remember that he must find the average force, suggest that he review page 114. Check his responses to questions 10-9, 10-10, 10-11 and 10-12. (4) Reassess, using an alternate check.

05 Core 4

Defines *kinetic energy* operationally.

The student generates an operational definition for *kinetic energy* which includes detection of KE by observing movement of an object or a change in the position of a reference point on the object and the measurement of KE by measuring the amount of work the moving object can do on some other object.

Student Action: Stating in effect that he would detect the movement of an object by observing the change in its position from a reference point and that he would measure the amount of work the moving object can do on some other object. The mathematical statement $KE = \frac{1}{2}ms^2$ is also an acceptable answer for describing how it can be measured.

Performance Check A: Give an operational definition of *kinetic energy*.

Remediation: (1) If the student cannot operationally define *kinetic energy*, suggest that he review pages 105 through 107 on "Measuring Motion Energy." Check his response to questions 9-16, 9-[illegible], and 9-20. (2) Also, check his response to question 10-20. A discussion on how the student measured the kinetic energy of the cart may be necessary. (3) If the student has done Excursion 19, you may wish to refer him to this mathematical relationship for kinetic energy.

05 Core 5

Describes a way to detect kinetic energy.

The student applies the definition that kinetic energy is the energy of motion of an object.

Student Action: Stating that its presence can be determined by observing motion or a change in the position of the object.

Performance Check A: A motor is connected to a battery. How can you tell if the motor has kinetic energy?

Remediation: (1) Ask the student to operationally define *kinetic energy*. If the student cannot do this, see the Remediation for 05-Core-4. (2) If the student cannot relate the operational definition for *kinetic energy* to the specific situation, a discussion may be beneficial.

05 Core 6

Describes a way to measure kinetic energy.

The student applies the concept that the energy of a moving object can be measured by determining how much work it can do.

Student Action: Stating that he would measure the amount of work the object does. The mathematical statement $KE = \frac{1}{2}ms^2$ is also acceptable.

Performance Check A: What would you do to measure the amount of kinetic energy a moving cart has?

Remediation: See the Remediation for 05-Core-4.

05 Core 7

Selects the conditions of maximum kinetic and potential energies of an elastic object.

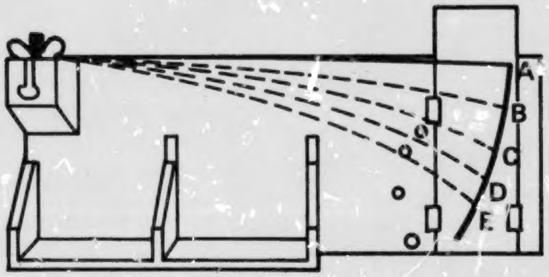
The student applies the concept that the potential energy of an elastic object when bent within the range of its elasticity has the greatest potential energy when bent to its limit and the greatest kinetic energy when released from that point and observed at its position of least tension.

Student Action: Selecting the letter of the position of greatest tension as the position of greatest potential energy and after release the letter of the position of least tension as that of the greatest kinetic energy.

A, **B**, and **C**: 1. E, 2. A

Performance Check A: Study the diagram below. Jean pulled the blade of her force measurer all the way back to position E and released it.

1. Identify by letter the position at which the potential energy of the blade was the greatest.
2. Identify by letter the position at which the kinetic (motion) energy of the blade was the greatest.



Remediation: (1) If the student missed part 1, discuss Table 10-1, page 117, with him. Compare Trial 1 and Trial 2. In which case is the potential energy of the blade the greatest? Where was the force measurer pin when potential energy was greatest, at position 2 or position 3? Therefore where will the potential energy be the greatest in the present case? (2) If the student missed part 2, discuss Figure 10-2, page 116, with him. When was the motion energy of the cart the greatest in this figure? Why? When, therefore, will the kinetic energy be the greatest in the present case? (3) You may want to ask the student to reevaluate his responses to Self-Evaluation Checks 10-3 and 10-4. (4) Reassess, using an alternate check.

05
Core
8

Selects the net amount of two forces acting on an object and its direction.

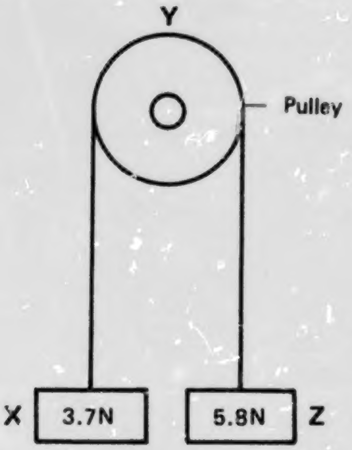
The student generates a solution to a problem which combines determining the amount of net force acting and determining the direction of movement when two unequal opposing forces are involved, which agrees with the concepts that when two opposing forces are acting on an object, any movement will be in the direction of the larger force and its amount is determined by the difference between the two.

Student Action: Selecting the direction of the force and the amount of net force.

A: 1. X to Y, 2. 2.1 N
B: 1. N to M, 2. 2.5 N
C: 1. D to E, 2. 1.4 N

Performance Check A: An object at X weighs 3.7 N. A second object at Z weighs 5.8 N.

1. Which of the following states the direction of movement: X to Y or Z to Y?
2. Which of the following correctly states the amount of force acting to produce the motion: 9.5 N, 2.1 N, or 21.5 N?



Remediation: (1) Ask the student which object in the diagram weighs more. In which direction will the system move? (2) What is the difference between the weights of the two objects? (Have the student set up a pulley system with unequal weights and do the activity if he wishes to.) (3) Reassess, using an alternate check.

O5 Core 9

Recognizes changes in the speed of a water-clock cart from a water-drop record.

The student classifies changes of speed and constant speed from a water-drop record showing the motion of a cart with the position of the cart indicated at regular intervals as follows: (1) the cart is increasing in speed when the distance between the drops increases, (2) the cart is decreasing in speed when the distance between the drops decreases, and (3) the cart is maintaining a constant speed when the distance between the drops is constant.

Student Action: Listing the appropriate intervals.

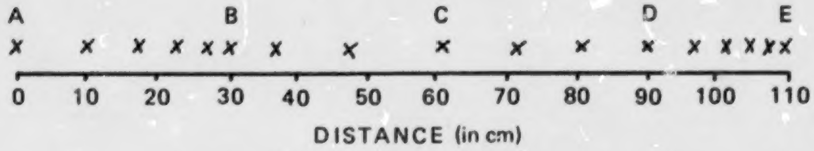
A: 1. Increasing from B to C; 2. Decreasing from A to B and D to E; 3. Constant from C to D

B: 1. Increasing from C to D; 2. Decreasing from A to B and D to E; 3. Constant from B to C

C: 1. Increasing from A to B and C to D; 2. Decreasing from D to E; 3. Constant from B to C

Performance Check A: Look at the record of the movement of a water-clock cart. This record was made by a moving cart which dropped a drop of water every two seconds.

1. List the letters between which the cart's speed is increasing.
2. List the letters between which the cart's speed is decreasing.
3. List the letters between which the cart's speed is constant.



Remediation: (1) Have the student review page 112, where he was introduced to the water clock and its use. (2) Check his responses to questions 10-4, 10-5, 10-6, and 10-7 and review these answers with him if necessary. (3) Reassess, using an alternate check.

05 Core 10

Names the force that causes objects to roll down inclines naturally.

The student classifies gravity (weight) as the force which gives motion to objects that roll down inclines when neither pushed nor pulled by a force other than gravity.

Student Action: Responding that the force is gravity or weight.

Performance Check A: Suppose you put a ball on an inclined plane and release it without pushing it. What force causes the ball to roll down the incline?

Remediation: Suggest that the student review page 110 for a discussion of gravity. What force causes any object to roll (fall) in a downward direction?

05 Core 11

Names the force which causes rolling objects to slow down.

The student classifies friction as the force that causes a rolling object to slow down and stop.

Student Action: Responding that the force is friction.

Performance Check A: What force causes a marble rolling across the floor to slow down and stop?

Remediation: (1) Have the student review page 68 of Chapter 7 where friction is discussed. (2) Friction acting on a non-self-powered object (specifically, the cart) is discussed on page 110.

05 Core

Names the force which reduces useful output energy.

The student classifies friction as the force which reduces the useful output energy of an energy converter.

Student Action: Naming friction as the force.

12

Performance Check A: An electric motor is an energy converter in which electrical energy is changed to useful output kinetic energy. When the output mechanical energy is measured, however, it is always less than the input electrical energy. What force is responsible for this decrease?

Remediation: (1) Does the student know the difference between output and input energy? If not, have him review Chapter 6, page 59. (2) If the student doesn't realize that friction is the force which causes input work to be greater than output work, have him review page 64, where this concept is introduced. Check his responses to questions 6-25, 6-26, and 6-27. (3) Also check his response to question 10-36 on page 123. A discussion can be centered around this response, focusing on why the potential energy of the spring blade was greater than the kinetic energy of the cart.

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05 Core 13

Compares amounts of input work with amounts of output work.

The student applies the concept that input work on a system is always greater than output work in such a way that he selects a possible amount of output work and his reason for choosing it.

Student Action: Selecting the lowest amount of output work and the letter of the statement of the concept that input work on a system is always greater than output work.

A: 1. a, 2. c
B: 1. b, 2. a
C: 1. c, 2. a

Performance Check A:

1. Write the letter of the best choice to complete the following sentence. When 84 newton·meters of input work is done by a horse on a treadmill, the treadmill might do
   a. 81.5 newton·meters of output work.
   b. 84 newton·meters of output work.
   c. 88.5 newton·meters of output work.
2. Write the letter of the reason for your choice.
   a. Because the horse doesn't waste any energy
   b. Because the treadmill saves work, as a machine does
   c. Because in a system input work is always greater than output work

Remediation: (1) Have the student review page 64 which introduces the principle that input work is greater than output work. (2) A discussion of Figures 10-2 and 10-3 and also Table 10-1, page 117, would be beneficial. Here the student can compare input and output work directly and see their relationship.

05

Relates friction to temperature change.

The student applies the concept that energy used to overcome friction causes an increase in temperature.

Core 14

Student Action: Selecting the term *increase*.

Performance Check A: Choose the correct word to complete the following sentence. "Hot-rod" Saxon always spins the wheels of his Corvette when he takes off from the school parking lot. This causes the temperature of the tires to (increase, decrease, stay the same).

Remediation: (1) Suggest that the student review Activity 5-11, page 64. In this activity, heat energy is first associated with friction. (2) This concept is investigated again on page 123. Discuss Figure 10-4 with the student. What happens to the temperature of a system in which there is a lot of friction?

05 Core 15

Lists several forms of energy.

The student recalls five or more of the following forms of energy: heat, light, electrical, potential, kinetic (motion), mechanical, sound, chemical, atomic (nuclear), and magnetic.

Student Action: Listing five or more of the following forms of energy: heat, light, electrical, potential motion (kinetic), mechanical, chemical, sound, atomic (nuclear), magnetic.

Performance Check A: Energy occurs in many forms. List six of these forms.

Remediation: (1) Have the student review the activities in Chapter 11 in terms of the energy change which occurred in each activity. (2) Also suggest that he check his response to Self-Evaluation Check 11-1. (3) Check the last column of Table 11-1 to see that he has the correct energy change listed for each activity. This could initiate a good discussion on different forms of energy in the Chapter 11 activities.

05 Core 16

Selects relative amounts of potential and kinetic energy.

The student applies the concept that an object which is lifted and dropped gains potential energy as it is lifted with kinetic energy, has maximum potential energy and no kinetic energy at its maximum height, loses potential energy and gains kinetic energy as it falls, and has no potential energy and maximum kinetic energy when it strikes the floor.

Student Action: Selecting the number and letter for each description which indicate the correct energy change.

A: 1. a, x; 2. d, y; 3. b, w; 4. c, z
B: 1. e, n; 2. h, o; 3. f, m; 4. g, p
C: 1. a, o; 2. d, p; 3. b, n; 4. c, m

Performance Check A: Think of the changes in energy that occur in the following situation. A box

1. is lifted from the floor,
2. reaches its maximum height of 2 m and stops,
3. falls, and
4. is about to strike the floor.

For each numbered step above, select two things from the table below – the letter (a, b, c, or d) of the phrase which describes the potential energy of the box at that moment and the letter (w, x, y, or z) of the phrase which describes the kinetic energy of the box at the same moment.

Potential Energy	Kinetic Energy
a. gains potential energy	w. gains kinetic energy
b. loses potential energy	x. receives input of kinetic energy
c. lowest potential energy	y. no kinetic energy
d. greatest potential energy	z. greatest kinetic energy

Remediation: (1) Be sure that the student has a clear understanding of potential and kinetic energy. If a review is necessary, refer him to page 106 and discuss Activity 9-7 in terms of potential and kinetic energy change. Also, review questions 19-19 through 19-22. (2) Figure 11-1, page 128, provides another area of discussion. See if the student can tell you the potential and kinetic energy changes in the rising and falling sinker. (3) Ask the student to review his answers to Self-Evaluation Checks 10-4, 10-5, and 10-6.

O5
Core
17

Describes a procedure for detecting and measuring light energy.

The student generates a procedure for detecting and measuring light energy.

Student Action: Stating in effect that light can be detected by observing a reaction which it causes in some object such as the paddle wheel of a radiometer or the needle of a light meter and with the notion, or an example of it, that the intensity of the light can be measured by determining the amount of movement.

Performance Check A: Describe how you can tell if light energy is present in some way besides seeing the light or an object which the light illuminates. Also state what you would need to do to measure the amount or intensity of the light.

Remediation: (1) Ask the student how light did work in Chapter 11. What piece of equipment showed light doing work? (2) Suggest that the student use the radiometer again and see if he can detect light energy. Suggest that he use different intensities of light. (3) How can he prove that light can do work (by using a radiometer)? How can he measure the amount of light? (What happens to the paddle wheel when he changes the amount of light?) (4) Ask the student to check his response to Self-Evaluation Check 11-3.

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05 Core 18

Explains how light can be shown doing work.

The student applies the definition that work is evidenced by a change of the motion or the position of something in order to detect light as a form of energy.

Student Action: Naming a light meter or radiometer and stating that the motion in the light detector caused by the light, like the motion of the paddles of a radiometer or the movement of the needle of a light meter, indicates that work is done by light.

Performance Check A: Stephanie agreed that light could light up things and make them visible. She said light couldn't do work, though, and that therefore it isn't energy. Prove that Stephanie is wrong. Name an instrument which shows that light is a form of energy. Tell how the instrument shows that work is being done.

Remediation: See the related Remediation for 05-Core-17.

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05 Core 19

Selects the form of energy which moves the liquid in a palm glass.

The student classifies heat as the form of energy that causes liquid to move in a palm glass.

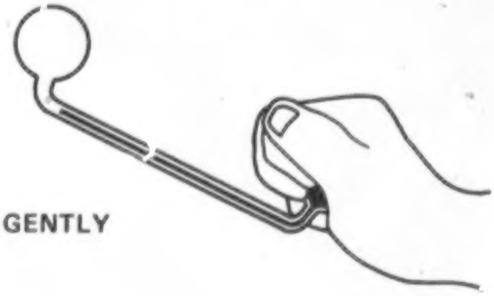
Regular Supplies: 1 palm glass

Student Action: Selecting "heat energy."

A: a
B: d
C: c

Performance Check A: Get a palm glass, and tilt it until all the liquid is in one of the bulbs. Hold the full bulb gently in your hand, as shown in the picture below. Be sure the cross tube is below the bulbs and the empty bulb is higher. Choose the correct answer below. What causes the liquid to move toward the other bulb?

a. Heat energy
b. Light energy
c. Pressure
d. Gravity



CAUTION: HOLD GENTLY

Remediation: (1) Refer the student to Activity 11-1, page 132, in which he used the palm glass. (2) Check his responses to questions 11-18 through 11-20 and discuss this activity with him if necessary.

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05 Core 20

Gives examples of electrical energy's being changed into kinetic energy.

The student applies the concept that electrical energy can be changed into kinetic energy by giving examples to illustrate it.

Student Action: Stating two examples in which electricity is used to operate an electrical device in which an object or part of it gains kinetic energy.

Performance Check A: Give two examples which show that electrical energy can be changed into kinetic energy.

Remediation: (1) By discussion, be certain that the student understands what electrical energy and kinetic (motion) energy are. (2) If the student has no difficulty with (1), he is probably having trouble thinking of examples. Use the example of an electric motor to show this type of energy conversion. See if he can identify other examples of motion, resulting from an object being supplied with electricity.

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05 Core 21

Labels the energy conversions of potential energy to kinetic energy and kinetic energy to potential energy.

The student classifies a situation as involving an energy conversion from potential to kinetic if an object gains motion because of a change in its position or from kinetic to potential if energy of motion is lost to change the position of an object so that it can release energy or as involving neither if there is no change.

Student Action: Responding with the letter representing the first stage of the energy conversion, using P for *potential,* K for *kinetic,* and N for *neither.*

A: 1. P-K, 2. K-P, 3. P-K, 4. K-P, 5. K-P, 6. N
B: 1. K-P, 2. P-K, 3. K-P, 4. P-K, 5. K-P, 6. N
C: 1. K-P, 2. P-K, 3. K-P, 4. P-K, 5. K-P, 6. N

Performance Check A: Read the following story. While working on Chapter 10, Johnnie put nails into holes 1 and 3 of the force measurer and pushed the cart back until the blade touched the nail in hole 3. (You may look at a force measurer if you wish.) Then he observed the following things.

1. The blade went forward (from hole 3 to hole 1) pushing the cart.
2. The cart lifted the sinkers.

His partner stopped the cart, but it slipped.

3. The sinkers fell.
4. The cart slammed into the blade and pushed it back from hole 1.
5. The cart went forward, raising the sinkers.
6. The sinkers lay flat on the floor.

Beside the number of each step, write P-K if potential energy is being changed to kinetic energy and K-P if kinetic energy is being changed to potential energy. Write N if there is no change in the form of energy.

Remediation: (1) If the student doesn't have a clear understanding of potential and kinetic energy, see the Remediation for 05-Core-19. (2) Discuss with him the activity described in Chapter 10. Have him turn to page 118 and discuss Activities 10-11, 10-12, and 10-13. The pictorial representation of the activity setup, found on page 119, is beneficial for the student. Discuss energy changes from potential energy to kinetic energy and from kinetic energy to potential energy in these activities and, if difficulties arise, refer back to the definitions of *potential energy* and *kinetic energy*. (3) Ask the student to reevaluate his response to Self-Evaluation Check 10-6.

05 Core 22

Recognizes the characteristics of energy.

The student classifies the statements "Energy can exist in more than one form," "Energy can be transferred from one system to another," and "Energy can be converted from one form to another" as characteristics of energy.

Student Action: Selecting characteristics of energy.

A: a, d, and e
B: b, c, and d
C: a, c, and e

Performance Check A: Write the letters of all the statements that identify characteristics of energy. Energy can

a. be converted from one form to another.
b. be measured by speed times distance.
c. be destroyed.
d. exist in more than one form.
e. be transferred from one system to another.

Remediation: (1) Where the student missed correct features of energy, suggest that he review the indicated activities.

Correct Feature	Suggested References for Review
Can be converted from one form to another	Palm glass, radiometer, or nichrome wire activities in Chapter 11, pages 131 and 132
Can exist in more than one form	Activity 11-12 on page 133
Can be transferred from one system to another	Use the example of the battery-charger system and the battery-bulb system, pages 129 and 130, to show energy being transferred between systems.

(2) Where the student chose incorrect features, review them with him to be sure he recognizes why they are incorrect.

05 Core 23

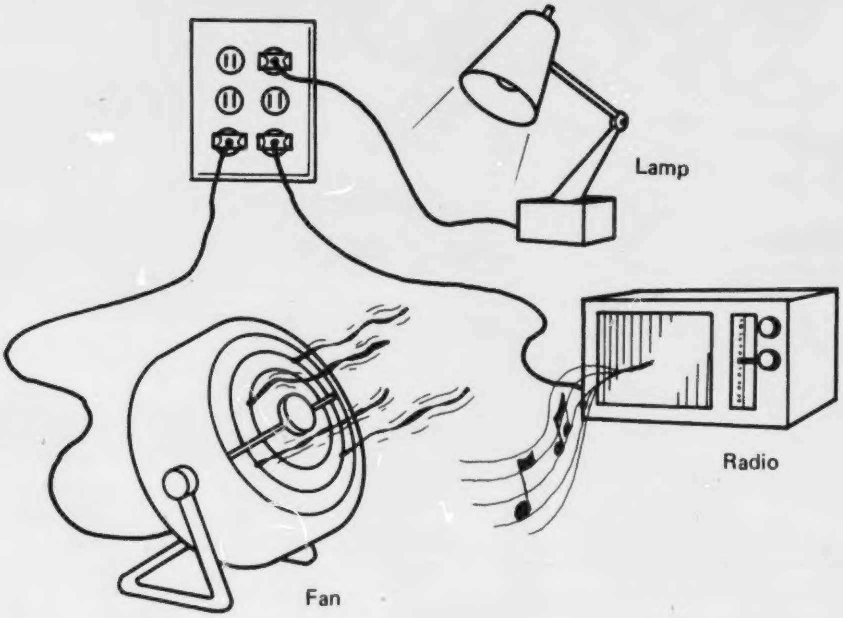
Names input and output forms of energy.

The student classifies electrical energy as the form of input energy and three of the four energy forms – light, heat, sound, and kinetic energy – as the output forms in a diagram.

Student Action: Responding that (1) electrical energy is the form of input energy and (2) with three out of four of the following forms of output energy: heat, light, sound, and kinetic (mechanical or motion) energy.

Performance Check A: Examine the diagram below.

1. State the form or forms of input energy shown in the diagram.
2. State the form or forms of output energy shown in the diagram.



Remediation: (1) If the student does not know the form of input energy, ask him what component supplies the energy for everything else. What form of energy does it supply? (2) If the student was unable to name the output forms of energy, check Table 11-1, page 135, in which he listed several energy changes. Also check questions 11-25, 11-26, and 11-27. Have him review the key activities in Chapter 11 to find the forms of output energy which he missed. (3) Check the student's response to Self-Evaluation Check 10-2a. (4) Reassess, using an alternate check.

05

Gives examples of energy converters.

The student classifies devices involving different input and output forms of energy by giving examples of energy converters and the input and output forms for each.

Core
24

Student Action: Naming three devices which perform energy conversions and the input and output forms for each.

Performance Check A: In your home, there are many things which convert one form of energy into another.

1. List three such energy converters found in your homes.
2. State the form of the input and the output energy for each. For example, light bulb: input energy – electrical; output energy – heat and light.

Remediation: (1) If the student doesn't know what an energy converter is, discuss the term with him. (2) If he is unable to list the input and output forms of energy, see 05-Core-23. (3) Reassess by having him give you examples of energy converters and the input and output forms of energy for each or by identifying the energy converters in Diagrams A, B, and C of Self-Evaluation Check 11-5.

05
Exc
20
1

Calculates the speed of a water-clock cart.

The student applies the rules for measuring the average linear speed of a water-clock cart by which the time interval between any two adjacent drops is calculated by dividing the time for N drops by the number of time intervals (N - 1) and the distance the cart moves between two adjacent drops is divided by the time interval so obtained.

Student Action: Calculating and reporting the speed of the water-clock cart.

A: 6 cm/sec
B: 8 cm/sec
C: 10 cm/sec

Performance Check A: A water clock drips 37 drops in 18 seconds. The water-clock cart leaves a trail of water drops 3 cm apart. What is the speed of the cart in centimeters per second?

Remediation: (1) Have the student review Excursion 20, pages 392 through 394. Check Table 20-1, especially the "Speed of Cart" column. The formula for calculating speed is shown on page 394.

05
Exc
21

Uses circumference and time of motion to calculate speed.

The student applies the rules for determining the speed in centimeters per second of an object around a disk in which he measures the circumference of the spinigig disk in meters to find the distance traveled and divides that distance by the time in seconds.

Regular Supplies:
1 spinigig disk
50 cm string
1 meterstick

1

Student Action: Calculating and reporting the speed within the range of a 10% error.

- **A:** 3.1 cm/sec (±0.3 cm/sec)
- **B:** 7.3 cm/sec (±0.7 cm/sec)
- **C:** 6.3 cm/sec (±0.6 cm/sec)

Performance Check A: Pepito, an ISCS student, noticed an ant walking around the circumference of a spinigig disk which hung in the rack. The timer was going, so he timed the ant. It took 14 seconds for each trip around. How far did the ant walk in one trip? At what speed was it moving? You may get a spinigig, 50 cm of string, and a meterstick to make whatever measurements you need. Show your measurements and your calculations. Report your answer in centimeters per second.

Remediation: (1) Suggest that the student review Excursion 21 in which he measured the speed of the cart in a circular path, noting page 402 especially. (2) Check his response to questions 21-11, 21-12, and 21-13 on page 402. Figure 21-3 can be used for discussion of how to measure circular motion if a problem still exists. (3) For all three forms of the performance checks, the distance around the disk is 3.14 X 14 cm, or 44 cm. Most students will get the 44 cm by direct measurement. Check the student's measurement or calculation.

05
Exc
22
1

Selects the variables which determine momentum.

The student classifies the speed and the mass of an object as the variables which determine momentum.

Student Action: Selecting the mass and the speed of the object as the variables which determine momentum.

- **A:** a, c
- **B:** b, d
- **C:** a, b

Performance Check A: The following things are known about a rocket.

a. It has a mass of 1,800 mass units.
b. It has a thrust of 750,000 lbs.
c. It has a speed of 17,500 miles per hour.
d. It has an acceleration of 0 to 7,000 mph in 4.5 sec.

Write the letter of each variable needed to calculate the rocket's momentum.

Remediation: (1) Suggest that the student review Excursion 22. (2) Check questions 22-14 and 22-15, page 410. (3) Does the student know what momentum is? Ask him to operationally define *momentum*. Refer him to page 410, and discuss momentum and the variables involved.